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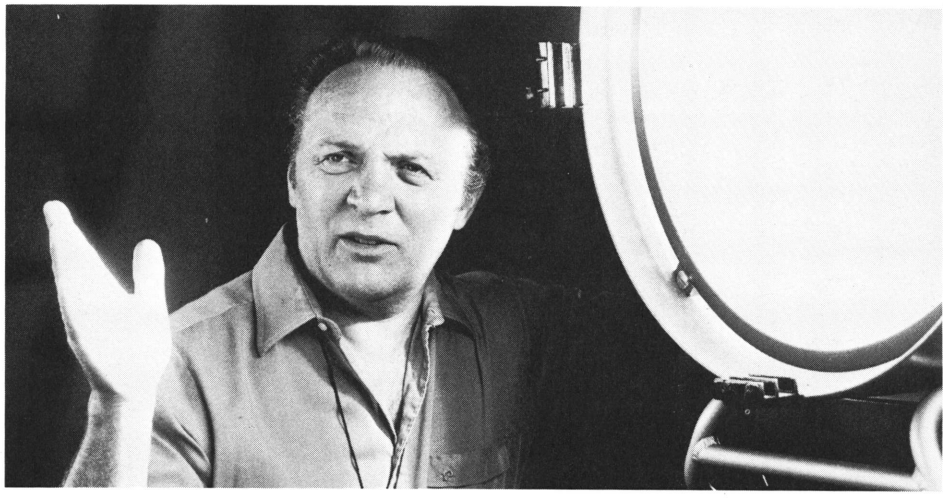
ELECTRONIC CINEMATOGRAPHY

In This Issue

PANACAM • VIDEO ASSISTED FILM EDITING

HIGH DEFINITION TELEVISION • POST AUDIO PROCESSING

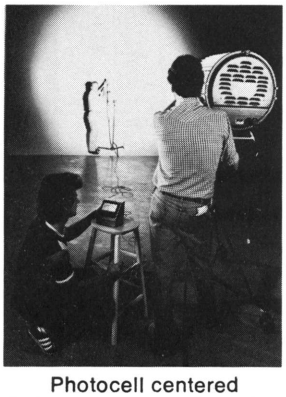
TABLE A	OUTPUT AT FULL FLOOD POSITION:	
BRAND X 4k		
DISTANCE	FOOT CANDLES	SPREAD
50 ft	94 fc	52 ft
40 ft	150 fc	41 ft
30 ft	260 fc	30.5 ft
20 ft	650 fc	20 ft
ARRI 4k		
DISTANCE	FOOT CANDLES	SPREAD
50 ft	128 fc	45 ft
40 ft	200 fc	36 ft
30 ft	380 fc	28 ft
20 ft	880 fc	18.5 ft



Above: Lighting Director Peter Edwards aligns ARRI 4k beam on plaster cyclorama.

Emmy-winning Lighting Director tests the ARRI 4k HMI® versus the competition:

After testing twice, Peter Edwards finds the ARRI has more output and less fall-off at the edges.



Photocell centered in beam with remote meter scale near lamphead.

TABLE B	FULL FLOOD OUTPUT, EQUALIZED SPREADS:		
LIGHT	DISTANCE	FOOT CANDLES	SPREAD
BRAND X	28 ft	340 fc	30 ft
ARRI	36 ft	360 fc	30 ft

Peter Edwards is Supervising Lighting Director at CFTO-TV in Toronto; and he is Chairman of The Society of Television Lighting Directors, Canada. He has won two Emmy Awards for his lighting.

"CFTO wanted to buy HMI lights for a series to be shot on location," says Mr. Edwards. "So we ran side-by-side tests comparing the 4k units of three imported brands. The ARRI 4k had by far the worst output."

"It turned out, as I suspected, that the ARRI unit had been misaligned. By the time another unit was available, we had bought the better of the other two brands. To satisfy our curiosity, we later decided to compare the second ARRI with the brand we'd bought."

"We duplicated our earlier test procedure. As Table A shows, the second ARRI unit had greater output than ours. The ARRI beam spread was more even, edge-to-edge, with a sharper drop-off. It wasn't as wide."

"To compare apples with apples, we pulled the ARRI unit back until its beam spread exactly matched the other light's. Table B shows the results. The ARRI's output was greater, even with the unit 20% further away."

"The ARRI's beam had almost the quality of a hard-edged spotlight," says Mr. Edwards. "Very linear across its field – unlike most Fresnels."

"To blend with another source, you could feather the ARRI's edge by spotting the fixture up a little and either pulling it back or dropping in a scrim. For single-source lighting, the ARRI's even field would make exposure much more consistent right across the subject."

"The ARRI unit is built like a tank. It's a handful, compared with the brand we bought; but you could rely on it to work in any weather, I should think, which is important for a location tool."

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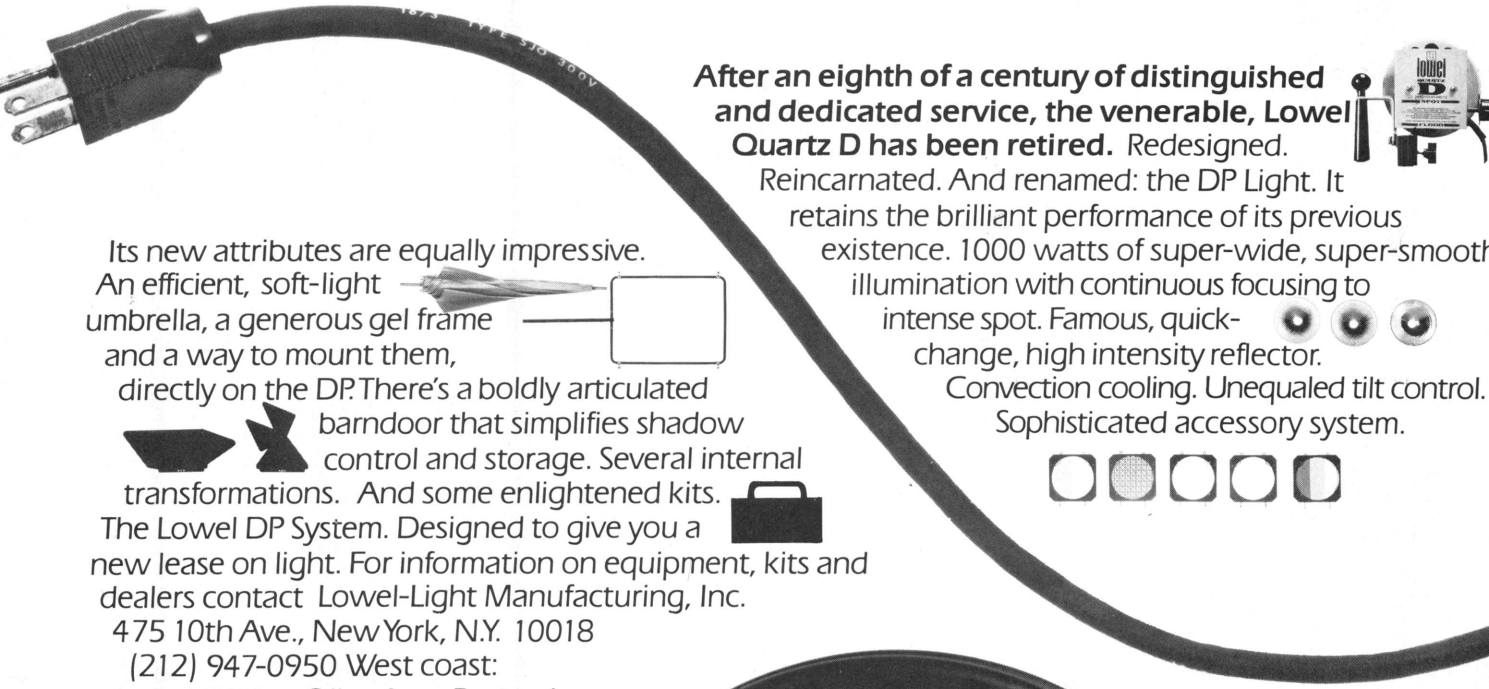

After an eighth of a century of distinguished and dedicated service, the venerable, Lowel Quartz D has been retired. Redesigned. Reincarnated. And renamed: the DP Light. It retains the brilliant performance of its previous existence. 1000 watts of super-wide, super-smooth illumination with continuous focusing to intense spot. Famous, quick-change, high intensity reflector. Convection cooling. Unequaled tilt control. Sophisticated accessory system.

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American Cinematographer

International Journal of Motion Picture Photography and Production Techniques

The American Society of Cinematographers is not a labor union or a guild, but is an educational, cultural and professional organization. Membership is by invitation to those who are actively engaged as Directors of Photography and have demonstrated outstanding ability. Not all cinematographers can place the initials A.S.C. after their names. A.S.C. membership has become one of the highest honors that can be bestowed upon a professional cinematographer, a mark of prestige and distinction.

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ON THE COVER: Special effects for the cover were accomplished through the courtesy of Editel in Hollywood using their Edit-1 suite equipped with a CDL-480 switcher, a Quantel DPE-5000 Plus digital effects generator and a Telemation character generator. The camera displayed on the screen is a Sharp XC-700 three tube prism optics color ENG/EFP camera. Photography by Jay Klapperman. Compositing by Daniel Catherine. Design by Richard Patterson.

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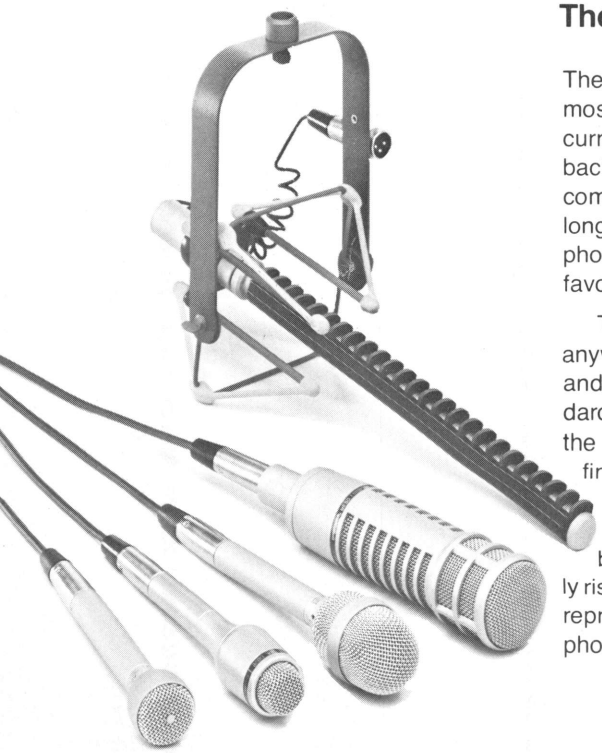
The 635A – Perfect design from the start



The Electro-Voice 635A is probably the most widely used broadcast microphone currently available. Yet it was introduced back in 1967! There are microphone companies that haven't been around as long as the 635A! What makes a microphone continue to be the broadcasters' favorite after 15 years in the field?

The 635A was designed to be used anywhere. Its screw-machined steel case and mechanically nested parts set standards for durability and ruggedness that the competition still strives for. It was the first omnidirectional microphone designed to have a shaped, rather than flat, frequency response. A rolled off bass response combined with a slightly rising high end make it perfect for vocal reproduction. And it was the first microphone of its type to feature an elastomer encased head capsule for reduced handling noise and additional protection from severe mechanical shock.

Despite all the technological advances in the broadcast, recording and sound reinforcement industries, the 635A continues to be the "audio man's screwdriver"-a microphone tool that can be used anytime, anywhere, for almost anything. When a product is designed right to start with, there's no need for it to become obsolete. All Electro-Voice professional microphones are designed with the same goal in mind. That's why people think of Electro-Voice as their microphone expert.

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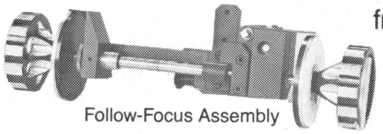
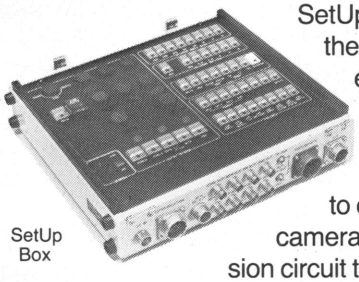


Follow-Focus Assembly

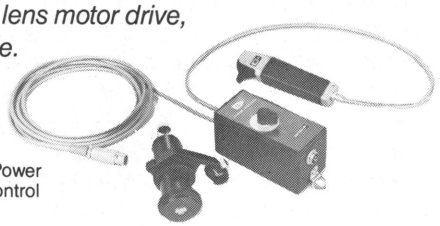
Use the EC-35 just as if you were shooting film for television. And here's what you'll get: Selectable gamma curves matching those of film and video; white compression capability and gray scale latitude. • Fully automated SetUp Box sets up and aligns the camera in seconds—eliminating the ongoing need for a video engineer. • Contrast ratio of 100:1, compared to only 20:1 for other video cameras. • A knee compression circuit that compresses signals from 600% of the rated signal to 100%. • A Dynamic Beam Stretch circuit stabilizes highlight signals as much as four stops in excess of normal peak video level. • Dynamic Beam focus gives sharper corner to corner detail.



SetUp Box

Other features: extremely high resolution and low noise (S/N over 57 db rms). • Full range of five interchangeable fixed focal-length lenses, and zoom lenses.

A full line of film style accessories manufactured by Cinema Products, including matte box, follow-focus assembly, zoom lens motor drive, etc. are available.



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WHAT'S NEW

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This 5" Fresnelite is much smaller and lighter than the standard "Polaris," yet maintains the same high quality and optical performance of Strand Century's Bambino line of instruments.

Polaris Bambino accommodates both 120V and 220 or 240V lamps from 500 to 1000 watts. Supplied complete with 12 feet of cable and inline switch. Full line of accessories available. Overall dimension: 9"(W) x 14"(H) x 10"(D). Weight including cable: 8 lbs.

Other Strand Century/Ianiro Bambino *Fresnelites* Fresnels include: 6" (2KW), 10" (5KW), and 15" (10KW).

For further information, contact Strand Century, Inc., 20 Bushes Lane, Elmwood Park, New Jersey 07407, (201) 791-7000; or 5432 West 102nd Street, Los Angeles, California 90045, (213) 776-4600.

•

S&S "TOUR DIRECTOR" MAKES MULTI-IMAGE TRANSPORTABLE

Even complex multi-image productions may now be moved with relative ease from one location to another with the new Tour Director, introduced by Spindler & Sauppe, Inc., North Hollywood, California. The four-projector Tour Director system is capable of playing back sophisticated Director 24-Z productions, complete with Dolby stereo, yet the entire package weighs only a few pounds and travels neatly under an airline seat.

The system may be used with integrated "live" and "canned" presentations as well as totally automated productions. The high quality cassette deck and ADX decoder can play back ADX digital information from either the Director 24-Z or the new S & S Director 12-Z and a ribbon cable output makes possible the automation of up to 16 projectors.

The built-in dissolve has remote control sequential operation either forward or reverse for a 2 or 4 projector loop, plus tape re-start.

The Tour Director includes full stereo power amps with Dolby noise reduction system and full-time P.A. A specially designed case accommodates 3-way stereo speakers, P.A. mike, remote controller, and cables.

For further information, contact James W. Hulfish, (213) 764-1800, or write Spindler & Sauppe, Inc., 13034 Saticoy St., North Hollywood, CA.

•

SPSE 35TH ANNUAL CONFERENCE MAY 9–14 IN NEW YORK

The 35th Annual Conference of the Society of Photographic Scientists and Engineers will be held at the Genesee Crossroads/Holiday Inn in Rochester, NY on May 9–14, 1982.

According to Fred Guevara, Eastman Kodak Company, the conference chairman, the meeting will include a wide range of technical session topics of high current interest, including Electrophotography, Optical Disc and Chemical Recovery. Also proposed are sessions on Electronic Image Recording, Laser Recording and Business Graphics, among others. Papers Chairman for the conference is Dr. Alfred P. Marchetti of the Kodak Research Laboratories.

The 35th Annual Conference begins on Sunday afternoon, May 9, with registration and the traditional welcoming reception. The social program also features an evening on "The Avenues," Rochester's downtown cafe district, and a gala reception at the elegant George Eastman House, an international museum of photography.

Advance registration fees for the conference are $195 for SPSE members and $235 for non-members ($40 may be applied to Society Membership). There is an additional charge for registration during the conference. Student members of SPSE may attend the conference without charge. Students who are not members of SPSE will be charged a $10 registration fee.

The Society of Photographic Scientists and Engineers is an international group of members. The SPSE publishes two journals: *Photographic Science and Engineering* and *Journal of Applied Photographic Engineering*. Their publication program includes several books and manuals and proceedings and abstracts. SPSE sponsors conferences on photographic science and engineering the year around.

For information on the 1982 Conference or on the SPSE, its services and activities, write to the Society of Photographic Scientists and Engineers, 7003 Kilworth Lane, Springfield, VA 22151; or call (703)642-9090.

•

LIGHTWEIGHT RANK LENS PROVIDES FIXED FOCAL LENGTH QUALITY IN HAND-HELD ZOOM LENS.

Rank Precision Industries has just introduced its new lightweight Cooke Varo Panchro Lens—designed to give fixed focal lens quality to hand-held zoom shots. This lens has a 20-66 focal length range, a maximum T/stop of 3.1, and a focusing range as close as 25 inches from the film plane. With superior resolution to previous standard-setting Cooke lenses, the new Cooke Varo Panchro lens is supported by the same service bases as other Cooke lenses in the Los Angeles, New York and Chicago areas. For information, contact Rank Precision Industries, 411 East Jarvis Ave., Des Plaines, IL 60018 (201) 391-7295.

•

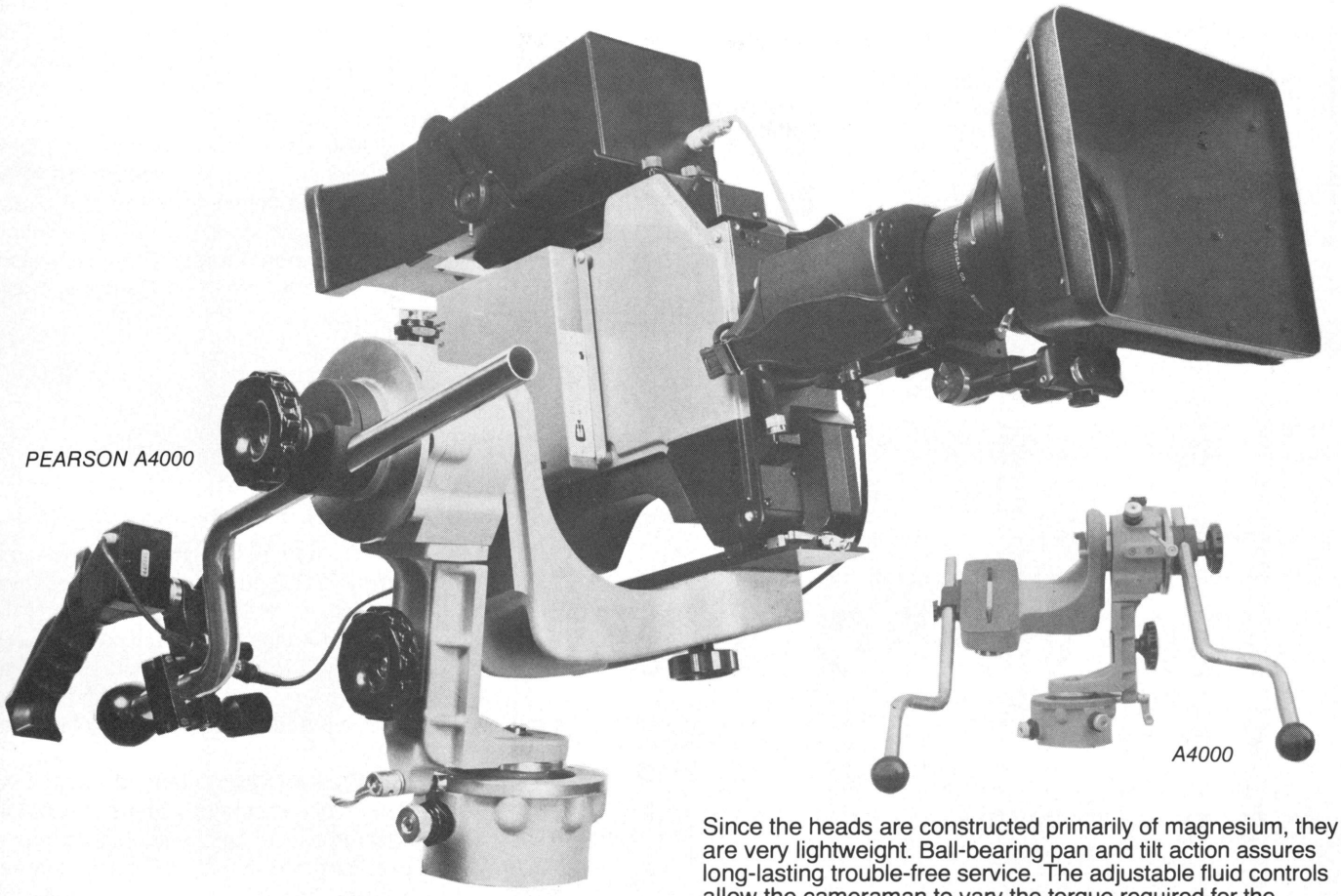
TWENTY-ONE TECHNICAL ACHIEVEMENTS CONSIDERED FOR ACADEMY AWARDS

Twenty-one technical achievements of the past year have been selected to be considered for the 54th Annual Academy Awards, it has been announced by Joseph Westheimer, Chairman of the Academy's Scientific or Technical Awards Committee.

Those methods or devices being studied by the committee and the companies submitting them are: Film Processor "Stroboscan Viewer," Consolidated Film Industries; Film Facit Projector, Lab Methods Corporation; PT35-JR Sound Projector, Universal Projector Company; Christie P35 Motion Picture Projector and Soundhead, Christie Electric Corporation; The Burbank Studios' 24-Frame Video System, The Burbank Studios; Universal/Ruxton 24-Frame Video System, Universal City Studios/Ruxton, Ltd.; Pitching Lens, Continental Camera Systems; Beam-Splitter Optical Composite Printer, Industrial Light and Magic; Universal City Studios' Two-Format, Rotating Head, Aerial Image Printer, Universal City Studios.

The Empire Camera System, Industrial Light and Magic; Cool Light Lighting System, Cool Light Company; Prostar Film Processor, Eastman Kodak Company;

NO SPRINGS ATTACHED!



PEARSON A4000

A4000

The Pearson fluid head provides "springless counterbalance" for a wide variety of film and video cameras.

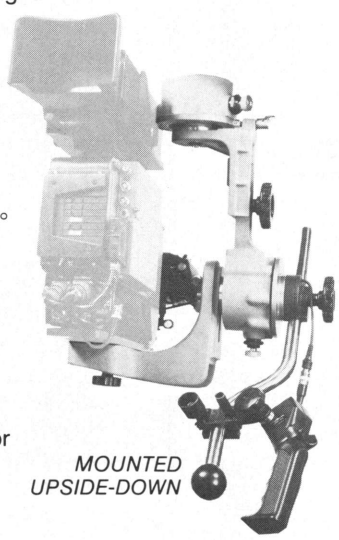
Since the heads are constructed primarily of magnesium, they are very lightweight. Ball-bearing pan and tilt action assures long-lasting trouble-free service. The adjustable fluid controls allow the cameraman to vary the torque required for the smoothest pans and tilts. And there are two models. The A4000 is designed for small to medium size cameras, whereas the Dual A4000 is designed for larger cameras and video cameras with handle-mounted zoom and focus controls.

Springless counterbalance is possible since the camera mounting platform is designed below the fulcrum point of the head. The camera mounting yoke is adjustable to match the camera's center-of-gravity height.

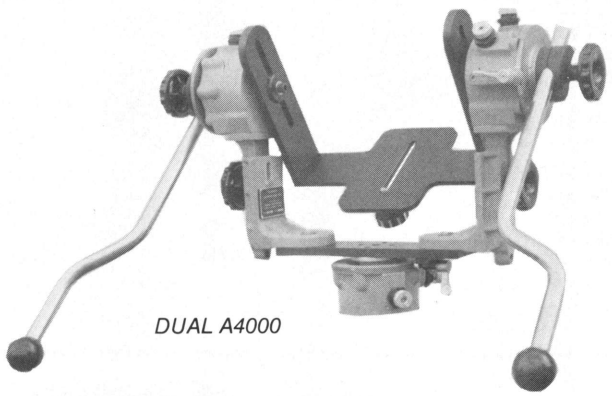
Counterbalance of any camera is of ultimate importance to every cameraman. It allows you to tilt the camera to any position and release the handle *without it moving!*

The adjustable fluid tension allows fingertip control of 360° pans and tilts. Unlike any other fluid camera head, the Pearson A4000 is capable of making a full 360° tilt with many models of cameras.

The unique design of the Pearson head allows it to be mounted upside down, providing a low optical axis for ground level and table top filming.



MOUNTED UPSIDE-DOWN



DUAL A4000

Just think of those times your tired arms tried to hold the camera in an awkward tilt position and still get a steady shot. Now, forget them. The Pearson fluid head achieves perfect counterbalance and . . . *with no springs attached!* Call or write for details.

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The OSF Microcosmic Zoom, Oxford Scientific Films; The Cosmoglide, Pathfinder and Stellaglide Camera Suspension Systems, Oxford Scientific Films; The Introvision System, Introvision Systems Company; Baryfol Sound Barrier Materials, John M. Wylder; Fujicolor Negative Film A250, Fuji Photo Film Company; Tyler Mount, Tyler Camera Systems; and Go Motion Figure Mover, Industrial Light and Magic.

Also under consideration and being studied by surrogates who will report their findings to the committee are: A System for Eliminating Roll Bars While Filming a Television Image, Fred R. Wilson; and "Clens" Make-up Remover, Steven Clensos.

•

ELECTRO-VOICE INTRODUCES XEQ-2 CROSSOVER/EQUALIZER

(Buchanan) Electro-Voice introduced the XEQ-2, a new active crossover/equalizer, at the recent Western NAMM held in Anaheim. The unit is designed to be used with E-V's professional and music low-frequency enclosures and patented HR and RC models of Constant Directivity horns.

The XEQ-2 is intended for use with bi-amplified sound systems. The particular crossover and equalization characteristics are determined by plug-in modules. Three crossover modules are supplied with the unit. The X500 and X800 modules provide crossover frequencies of 500 and 800 Hz respectively. Additionally, a blank module is supplied to allow the user to construct a crossover module for any other frequency between 100 and 8,000 Hz. 125 Hz, 1,500 Hz, 3,500 Hz and 7,000 Hz crossover modules are also available from Electro-Voice as accessories.

Horn/driver equalization plug-in modules must be ordered separately and will vary depending on the particular E-V Constant Directivity horn chosen. A "flat" plug-in module is supplied with the XEQ-2. In addition to the plug-in modules, a continuously variable control allows the user to tailor high-frequency response above 5,000 Hz.

The XEQ-2 also features a unique variable time delay circuit in the low-frequency output section. At typical crossover frequencies, the delay can be adjusted between 0 and 2 milliseconds. This gives the user the ability to smooth frequency response in the crossover region—something that is not possible with conventional crossover networks.

The XEQ-2 has a pro user net of $349.95. For further information on the XEQ-2 write Electro-Voice, Inc., Dept. 38, 600 Cecil Street, Buchanan, Michigan 49107.

•

METER FOR HMI LIGHTS

An HMI frequency checker dubbed the CINE-CHECK from Cinematography Electronics is now on the market. The CINE-CHECK will determine exact pulse rate of any HMI light. Allows you to determine beforehand if unstable line frequency, particularly from generator source will cause HMI flicker. Housed in a rugged compact handheld cast aluminum case, the CINE-CHECK will keep you within a ± .01 Hz. The CINE-CHECK allows you to keep an accurate check on FPS of any mirror reflex camera. By directing a penlight into the viewfinder and holding the CINE-CHECK in front of the camera lens, it will indicate in bright four-digit LED display exact frame range. Priced at $495.00; leather field case at $16.95. Contact R.S. Kaplan Associates, 5000 Centinela Avenue, suite 239, Los Angeles, California 90066. (213) 391-8181. ■

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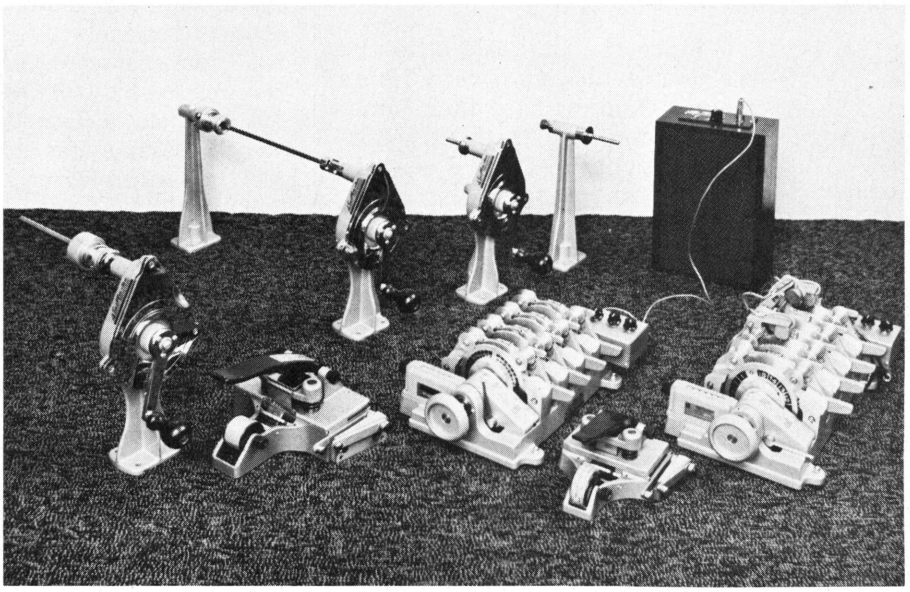

Australian made rewinders and synchronisers, part of the Easton range of professional 16 and 35mm editing equipment, which also includes program timers, wind-off plates and other accessories.

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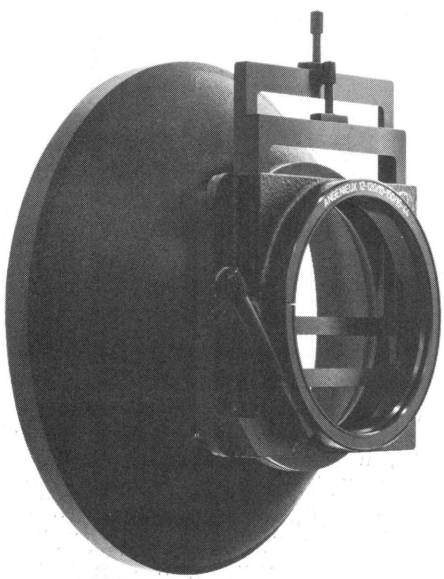

The Lightweight Mattebox has three basic components: a sunshade, a frame and an adapter ring.

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THE BOOKSHELF

BY GEORGE L. GEORGE

FACETS OF CINEMA

The comedic talent of Mel Brooks, his flair for wacky scripts, visual gags and incongruous non-sequiturs are effectively traced by Maurice Yacowar in METHOD IN MADNESS. This well-researched and perceptive study analyzes Brooks's films, TV shows and recordings for their form and content, their social concerns and intellectual connotations in a hilarious and erudite text (St. Martin's $12.95).

In THE MAKING OF RAIDERS OF THE LOST ARK, Derek Taylor describes the production of director Steven Spielberg's blockbuster. Detailed and informative, it reveals the technical and personal problems that confronted the film, keeping up a lively pace in its recounting of a complex enterprise (Ballantine $2.95).

A knowledgeable volume that delves into the techniques and practices of the metier, John Brady's THE CRAFT OF THE SCREENWRITER is based on in-depth interviews with such renowned practitioners as Neil Simon, Paddy Chayefsky and Ernest Lehman. Their expertise underlines the literary skills, visual imagination and personality traits required of a successful film writer (Simon & Schuster $16.95).

In THEATRE: STAGE TO SCREEN TO TELEVISION, William Torbert Leonard compiled a list of over 300 instances of this metamorphic process providing a valuable reference tool for librarians and scholars (Scarecrow, 2 vols. $74.50). The relationship between literary fiction and film is explored in THE ENGLISH NOVEL AND THE MOVIES, an insightful collection of 27 essays assembled by Michael Klein and Gillian Parker (Ungar $14.95/6.95).

Edited by Ralph Newman Schoolcraft, ANNOTATED BIBLIOGRAPHY OF NEW PUBLICATIONS IN THE PERFORMING ARTS (No. 40) describes expertly all such books published between 1/1/80 and 3/31/80. This is a comprehensive quarterly reference source indispensable for promptly locating relevant print material (Drama Book Specialists, 150 W. 52 St., NYC 10019; $1 per issue, $2.50/yr.).

A perspective on the British realist film movement, Eva Orbanz's JOURNEY TO

A LEGEND AND BACK assesses knowledgeably its rise in the early 1930s to the 1950s under the impetus of such filmmakers as Paul Rotha, Lindsay Anderson and Edgar Anstey (NY Zoetrope, 31 E. 12 St., NYC 10003; $11.95). In THE FILM IN HISTORY, Pierre Sorlin asserts cogently that historical movies are credible sources of social documentation, based on his close scrutiny of 20 major films (Barnes & Noble $21.50).

Gabe Essoe's twin volumes, THE BOOK OF MOVIE LISTS and THE BOOK OF TV LISTS quote top film/TV personalities on practically every conceivable subject from memorable dialogue lines to permissible cleavage and superstars' salaries (Arlington $12.95/8.95). Assembled by Alan Gadney, HOW TO ENTER AND WIN FILM CONTESTS and HOW TO ENTER AND WIN VIDEO/AUDIO CONTESTS provide comprehensive data on over 1800 international competitions (Facts On File $12.95/5.95).

THE FAMOUS AND THE RICH

A profusely anecdotal and extensively-researched biography by E. J. Kahn, Jr., JOCK: THE LIFE AND TIMES OF JOHN HAY WHITNEY tells of the multifaceted career of the millionaire sportsman. Interested in the arts, he was active in many Hollywood enterprises, notably with David O. Selznick on *Gone With the Wind* and with Samuel Goldwyn and was an early investor in Technicolor stock (Doubleday $19.95).

From Delilah Books, two attractive biographies distributed by Putnam. MARILYN LIVES! by Joel Oppenheimer explores movingly the mutual love affair between the sex goddess and an adoring public, with interviews of a wide assortment of admirers ($8.95); and ANN-MARGRET by Neal Peters and David Smith, a "photo extravaganza and memoir" displaying everything her fans expect ($24.95/12.95).

Pinky Tomlin, who parlayed one hit song into a screen and stage career, writes engagingly, in appropriately titled THE OBJECT OF MY AFFECTION, about the ups and downs of his unexpectedly successful professional and private life (U. of Oklahoma Press $12.50). In ACCORDION MAN, Myron and Randee Floren narrate their long association with television bandleader Lawrence Welk, a spiritually inspirational memoir with religious overtones (Stephen Green Press, Box 1000, Brattleboro, VT 05301; $12.95).

The first issue of the standard Hollywood casting guide, Players Directory, was released in 1937 by the Academy of Motion Picture Arts and Sciences. To commemorate this event, it now publishes a facsimile of this original edition, the 1937 ACADEMY PLAYERS DIRECTORY BULLETIN. Handsomely presented, this collector's item is a rich source of nostalgic recollections of the industry's history (AMPAS, $12 softcover, $25 hardcover, $100 deluxe edition).

Several successful books are now available in paperback editions. MEMO FROM: DAVID O. SELZNICK, selected and edited by Rudy Behlmer, is an invaluable Hollywood chronicle reflected by a driving personality (Grove $11.95). SWANSON ON SWANSON is the often sensational autobiography of the perennial star (Pocket Books $3.95). HISTORY OF A SURVIVOR: SUSAN HAYWARD by Beverly Linet tells of the rewards and tribulations of stardom (Berkeley $2.95). Hal Wallis's autobiography, STAR MAKER, evokes the producer's successful 60-year career (Berkeley $2.95). MINNE PEARL is the engaging memoir of the popular comedienne (Pocket Books $2.75).

TELEVISION TIDINGS

The influence on the cultural and social fabric of the country exercised by Hollywood-based industries—film, television, records—is appraised by Jeremy Tunstall and David Walker in MEDIA MADE IN CALIFORNIA. A lively and discerning survey, it presents an alarming view of what it perceives as the ingrown provincialism and latent megalomania of this creative community (Oxford U. Press $15.95).

From their experience as writers-producers of such series as *Mannix, Columbo* and *McCloud,* Richard Levinson and William Link reveal in STAY TUNED the inside workings of prime time television. Their appraisal of video's potential as a medium of true popular culture rests on their successful fights with networks to air controversial material handled with taste and skill (St. Martin's $11.95).

A comprehensive survey compiled and annotated by Larry James Gianakos, TELEVISION DRAMA SERIES PROGRAMMING, covers, in its 3rd volume, some 200 shows, as well as specials and documentaries broadcast during the 1975–80 period, with specific air dates/times, casts and synopses of all episodes (Scarecrow $25). ■

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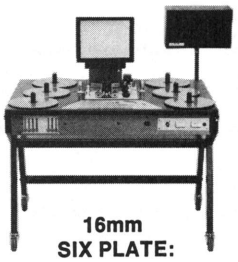

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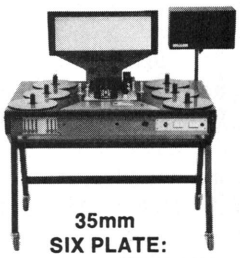

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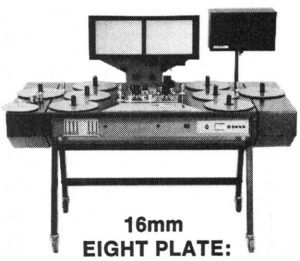

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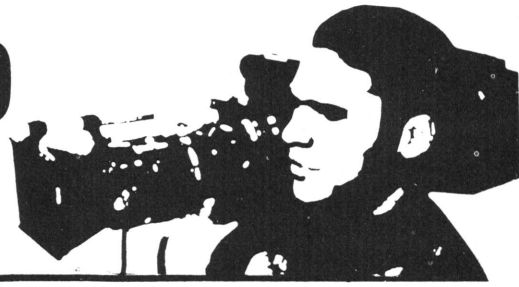

By ANTON WILSON

THE "FILM LOOK"

There is always lively debate when the relative virtues of film and video are discussed. In almost every arena of comparison the controversy rages. Whether it be production, post-production, special effects or long-term storage, each medium can be argued to have its specific advantages. The advent of the new Electronic Cinematography cameras is sure to add fuel to the already fiery debates on the subject by making differences between these formats even more subtle. However, before extolling the relative advantages of either medium, a very basic question comes to mind: Exactly what is it that makes film look different from tape on television? That is not an easy question and the complex answer has mystical, as well as technical, elements.

The "film look" enigma on television is even more intriguing when it is understood that a film to be displayed on television is rephotographed by a video camera. The "film chain" and "flying spot scanner" are the usual devices for converting a film into the video format for taping or broadcasting. Both these devices are essentially video cameras taking a video picture of the film. A hasty analysis of these facts could lead to the erroneous conclusion that film on television is somehow inferior to video tape. If film on television is nothing more than a video camera taking a picture of the film, why not have the video camera take the picture of the original subject in the first place, and save one generation? If film is just an extra step in the process, it seems logical that it must somehow detract or subtract something from the quality of the image. After all, who has ever seen the quality of an image improve with subsequent generations?

This train of thought, if continued, would lead to the belief that the video camera and its VTR yield the "live look" or the highest obtainable image quality, and that film is an extra or additional step in the process that can only subtract something from the image. These two beliefs then suggest that the "film look" could be electronically synthesized by manipulating the signal from a video camera. This supposition is based on the aforementioned premise that if film does not add a mystical quality, but rather subtracts something, why can't the subtracted entity also be removed electronically?

There is an intrinsic fallacy to this logic. Yes, film is an extra step in the video process, and yes, it does subtract something, but what it subtracts is certainly not quality, but rather some of the inherent shortcomings of the modern video camera. It is not true that a subtraction from an image necessarily means a reduction in quality. A filter is also a device that in most cases subtracts something from the image, yet, in most cases, the results are improved. A polarizer, for example, by subtracting certain rays of light, can yield a superior image from a scene with an otherwise excessively bright sky. A closer analysis of the subject adds greater significance to this analogy. Indeed, for the video process, film appears to be "anti-lag," "comet-tail eliminating," and a "low contrast" filter all in one. Film seems to be a buffer for these inherent problems that plague the modern video camera. What exactly are these problems and how does film help?

Film has some very nice inherent qualities relative to video. Most important, every frame of the film image starts on a virgin canvas. This may seem like a sophomoric statement, but it accounts for one of the biggest differences between film and video. After a frame of film is captured, the shutter closes and a brand new piece of film is advanced to the aperture. Thus, whatever happened during one frame cannot possibly affect any subsequent frames. The video camera, on the other hand, has only one target from which every frame is scanned. Thus what occurs during one frame can (and does) affect subsequent frames. Film is similar to drawing each frame on a new slate while video makes use of the same slate over and over again merely erasing each image with a less than ideal eraser before each subsequent frame. As a result, video is vulnerable to certain excessive conditions.

Video is very sensitive to overexposure. Very bright areas will "burn" into the target and not be completely erased, showing up as after images in subsequent scenes. Because of the electronic nature of the process, overexposed areas tend to "bloom" or "bleed" into adjacent areas. Indeed, areas even a half f-stop over maximum brightness will yield a "burned out," overexposed look. The inherent problem of incomplete erasure causes excessively bright areas to have a cumulative effect from frame to frame, thus aggravating the problem. Bright practicals or other lights that may get into the scene will "comet-tail" if the camera is moved rapidly. Thus, a round fresnel can appear shaped like an egg or teardrop if the camera is swiftly panned. The most limited aspect of video is its extremely narrow luminance ratio and abrupt transition into under and over-exposure. Video can only tolerate a luminance ratio of about 25:1 to 32:1. This is only 4½ or 5 f-stops. Moreover, shadow details below this range are usually lost, as are highlights that exceed maximum brightness. Film negative has a far broader luminance ratio of over 128:1 or more than seven stops. Equally important, film exhibits smoother transitions into over and underexposure. The gamma of film has a gradual knee and shoulder that helps capture shadow details and highlights by compressing the extremities of exposure.

Taking all these facts together, film becomes the perfect buffer for many of the shortcomings of the video camera. The video problems of lag, burning, blooming and comet-tailing are all precipitated by excessive highlights. Film absorbs these highlights and compresses them to levels that can be handled by the video camera without incurring the aforementioned side effects. Film can also bring up some shadow details that can be captured in the film chain, but that otherwise might have been lost in a pure video production. In general, a greater final range can be created by shooting film and transferring to video than can be achieved by a video camera. A more subtle color quality is also attributed to film. I believe all these effects add up to the elusive "film look" which quite often yields a far more pleasing image than that obtainable with a pure video production.

The technology of video is by no means standing still and video engineers are attempting to correct the weaknesses of the video process without the help of film, as we shall see next month. ■

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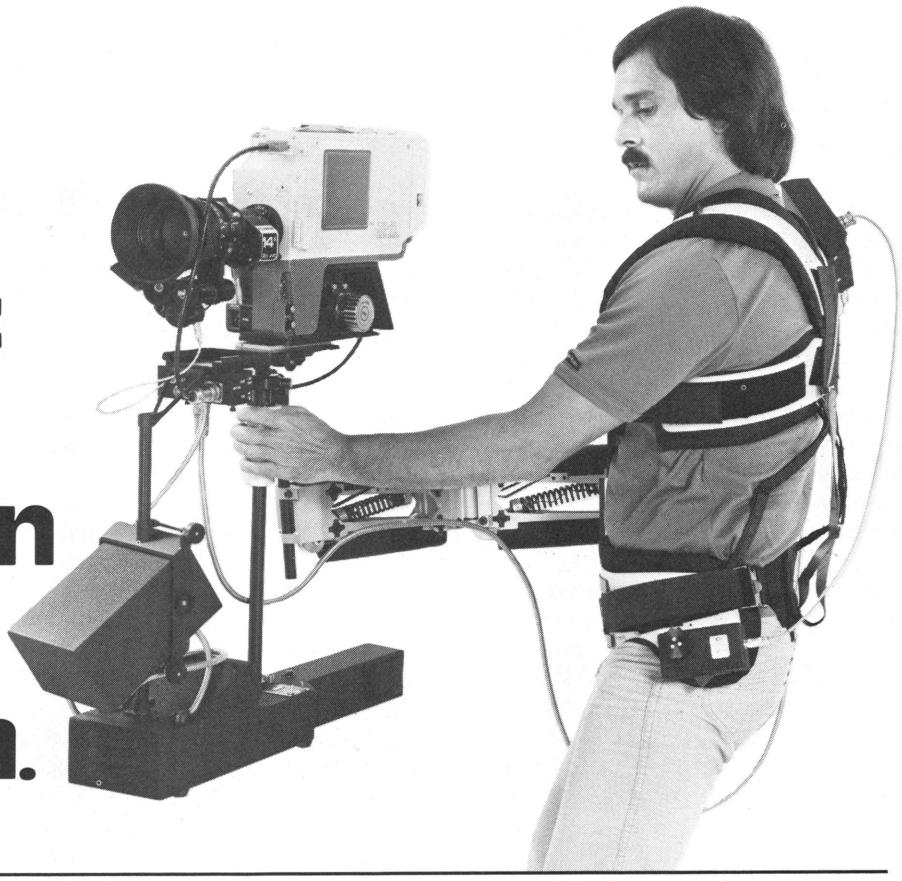

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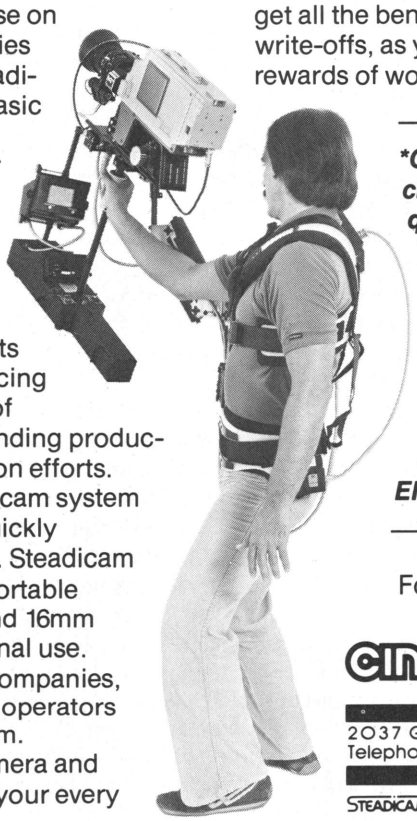

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TALKING TECHNICALLY

By DAVID W. SAMUELSON

HELICOPTER SHOOTING

To talk about the special techniques applying to shooting from a helicopter it is perhaps necesary to define what type of cinematography or "TVing" we are talking about.

Almost anyone can shoot from 500 or 1000 feet using only a wide angle lens and so long as he is focused on infinity and gets the exposure reasonably correct he will get good results, but helicopter shooting really starts where the dolly and the crane leave off and, with the application of skill on behalf of the pilot and the cameraman, it is possible to start a shot on a big head close-up of a person, using the long end of a 10:1 zoom lens, and finish up with the person a speck in the far distance—correctly framed, without camera wobble and in focus all the way.

You will note that I put the pilot first, because pilots who fly cameras are a relatively rare breed.

An analogy can be drawn with driving a motor car. Most of us would claim to be really good car drivers and any suggestion that we were not so would be taken as a grave insult to our virility, but compared to what Jackie Stewart or Carlos Reuterman can do with a car, most of us don't get to first base.

So it is with helicopter pilots. A pilot who spends most of his life doing taxi work or carrying pylons up mountains, no matter how safely and successfully, is not necessarily the Grand Prix camera pilot.

Good camera pilots are not only superb aviators, but insist they always see the dailies because, without doing so, there is no way to judge the effectiveness of their camera flying. Good camera pilots check out the tuning and balance of their helicopter and rotor blades before an important shoot and they take-off with a precise knowledge of how the flight has to look on the screen.

During the late sixties I had the privilege of flying many times with Gilbert Chomat, a legendary Frenchman whose credits include RED BALLOON, SOUND OF MUSIC, MAGNIFICENT MEN IN THEIR FLYING MACHINES, CHITTY CHITTY BANG BANG, MURPHEY'S WAR, BLUE MAX and many others. Regrettably, Gilbert and the famous English cameraman, Skeets Kelly, were killed on the film ZEPPELIN when a First World War replica aircraft flew into them, causing a mid-air collision.

Gilbert could position his helicopter within millimeters of where it was required, could hold it steady while his cameraman got his focusing and framing right and then pull away with the smoothness of velvet.

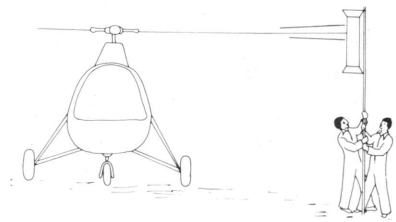
As important an aspect of helicopter camera work as any is the need to check that both the rotor and tail blades of the helicopter are perfectly balanced and pass through exactly the same plane, an operation known as "tracking." This used to be done by rubbing the ends of each blade with different coloured chalks and lightly holding a strip of fabric at the end of a pole towards them when doing a ground run-up test, but these days strobe lights are used which make the blades appear to stand still so that their relative positions can be accurately calibrated.

Cameramen have to realize that helicopters don't have magic sky hooks, but are like massive wood screws in air, whether they are hovering or flying in any particular direction, and that helicopters fly relative to the wind direction not the ground, that to change the flying direction or speed entails angling the whole helicopter so that the rotor blades "screw" into the air at the required angle to do so and that when flying close to the ground lift is affected by "ground effect."

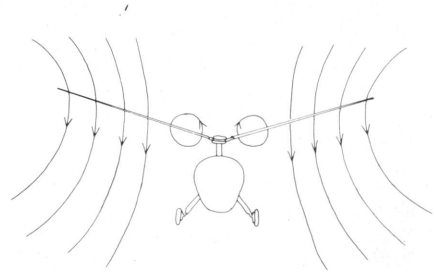
This all means that a knowledge of how a helicopter actually flies is a requirement to mastering helicopter camera work.

Taking the wind direction into consideration is very important when planning shots because helicopters fly forwards much more smoothly than they hover and very much more smoothly than they fly backwards or sideways and for critical work it may well be absolutely necessary to change the camera mount from one side of the helicopter to the other for optimum results.

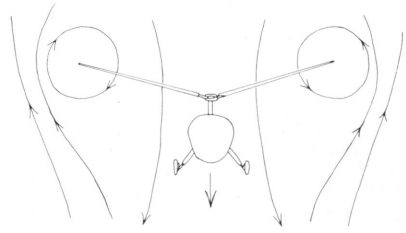
The fact that the whole helicopter body has to be tilted forward to change the angle of attack of the rotor blades relative to the horizon to translate from hover to forward flight, or whatever, means that the cameraman must know when this is going to happen and to allow for it if the horizon level is not to be tilted in mid-shot. When using a counter balanced mount, like a Tyler, this movement is automatically corrected for, but if not using such a mount, or using an anti-vibration system which only takes care of up-and-down and side-to-side vibrations, such maneuvers are best avoided if possible.



USING A FLAG TO CHECK HELICOPTER ROTOR TRACKING



HELICOPTER AIRFLOW PATTERN WHEN HOVERING



HELICOPTER AIRFLOW PATTERN DURING POWER DESCENT

Ground effect is a phenomenon that a skillful pilot can take care of, but which makes it difficult to take off and climb at a constant rate when flying close to the ground.

Further problems encountered by helicopters are down draught and other irregular wind effects. These are problems which can only be overcome to a certain extent. Better to keep the camera tucked inside the body of the aircraft so that the lens doesn't get caught up in the air stream, to weight down artists' clothes and fix their hair so they don't get ruffled, and to wet down the ground so that dust doesn't rise.

Filming from a helicopter is very much a team job between the pilot and the cameraman who have to think and operate as one, and on another occasion I shall write about setting and handling a helicopter camera mount and planning shots. ■

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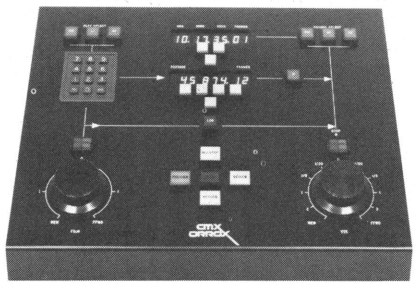

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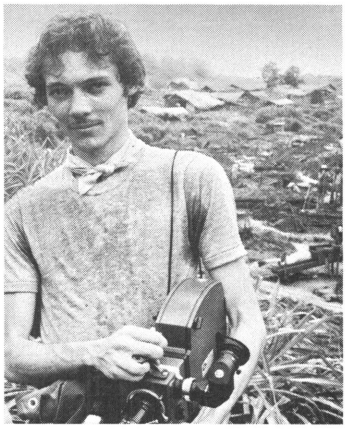
ELECTRONIC CINEMATOGRAPHY

Cinematography is the art of moving images. Although the term has traditionally been associated with photographic techniques involving chemical processes, it means literally the writing (or recording) of movement; and there is no reason to exclude other techniques capable of accomplishing the same thing. Recently the term electronic cinematography has been introduced to designate video techniques modeled after film techniques in contrast to live television. The difference is essentially a matter of the degree of control that can be exercised over each aspect of the production. Shooting "film style" with a single camera permits a greater degree of control over lighting, staging and composition. Editing sound and picture separately during "post-production" permits a greater degree of control over the total context in which the images will be viewed.

American Cinematographer is concerned with any technique or process which furthers the art of moving images. While we have no intention of sounding a death knell for film, we do recognize that the time has come to embrace fully the electronic image and all of the techniques for recording and processing it. In fact we recognize that we have some catching up to do.

This special issue marks the beginning of our commitment to making electronic technology more accessible to the film craftsman. Each issue hereafter will be expanded to include coverage of video production techniques without reducing in any way our coverage of film. At first the video content will constitute about a quarter of our expanded format, and the articles will emphasize fundamentals rather than assuming the reader is conversant with electronics and computer technology. Our new video editor is a filmmaker, not an electrical engineer; and it is our hope that all of our readers will accompany us on our journey into this brave new world with as much fascination and excitement as we feel.

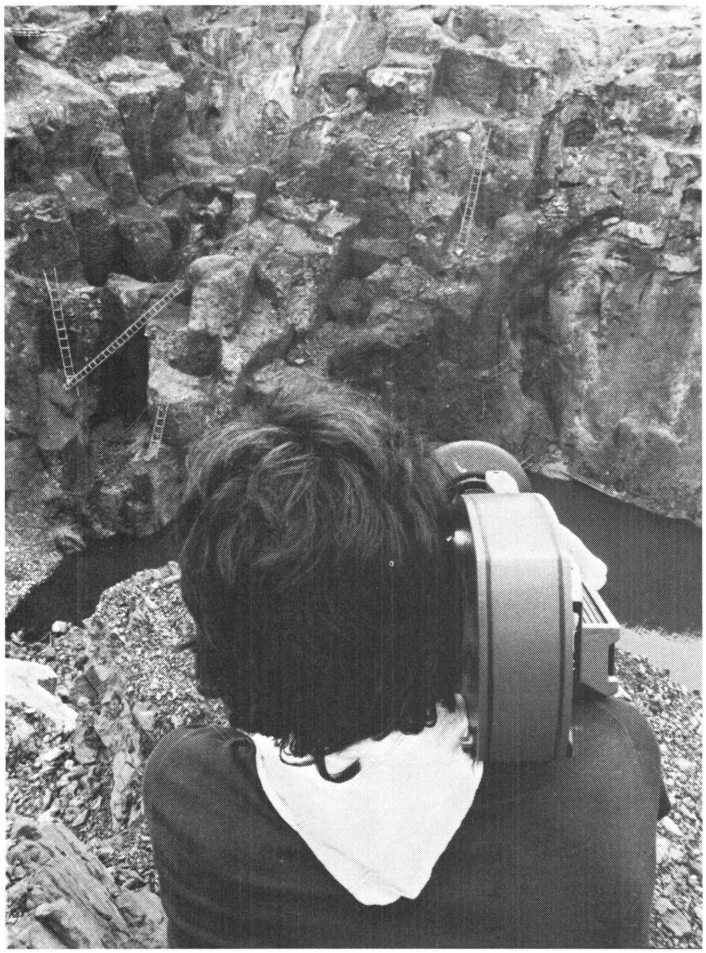
"Shooting in the intense heat and humidity of the Amazon jungle was the acid test for my GSMO. It came through with flying colors."



Jan Peterson
Cinematographer

"Working on the Amazon gold rush story for ABC-TV's *20/20 News Magazine* involved filming in the roughest terrain imaginable, in an area that is not even charted on the map —far away from any scheduled commercial flights that could rush replacement equipment, if necessary. And the nature of the terrain was such that we had to travel light, with no backup camera.

"I took a gamble on one camera: my own GSMO, equipped with two 400' cassette-load magazines, three plug-in batteries, and one Angenieux 9.5-57mm zoom lens," says Jan Peterson, the New York-based cinematographer whose recent credits also include a promotional documentary featuring Hollywood designer Edith Head.



Steep Inclines and Sudden Downpours

"For five days I was handholding my GSMO constantly. Carrying my gear in the intense heat, trekking up steep inclines, walking across deep ravines, climbing over giant fallen trees.

"It was the rainy season. Temperatures averaged around 100–105° F. We were constantly beset with heavy humidity, as well as subject to sudden downpours that turned everything into mud. There were times I couldn't even put the camera down for fear it would sink under. Yet none of this all-pervasive mud ever got inside the GSMO camera.

"What with all the dirt, the mud, the intense heat and extreme humidity, the Amazon jungle shoot was quite a test for the GSMO. Especially for the electronics of the camera. But GSMO came through it all with flying colors, performing flawlessly.

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TAPE OR FILM?

A producer with a story to tell or a show to put on has a choice to make before he can really begin production: Should he work in film or videotape? Today this question is not so easily answered as it was in the past. There are no longer any clear-cut reasons for using one medium or the other, and the factors that must be considered in order to make an intelligent choice can become very complex. One tongue-in-cheek argument offered on behalf of video production is that rust is cheaper than silver, and it is more fun to work in the light, than in the dark.

On the surface it would seem that the medium of distribution for which the product is designed would dictate the production medium. If you want something that can be projected on to screens with a mechanical apparatus, shoot film. If you want something that can be transmitted electronically, shoot videotape. Unfortunately it is not so simple. It is common practice to shoot certain kinds of television programs on film, and there is a great deal of interest these days in the feasibility of shooting on video tape for theatrical exhibition.

Film Look vs Tape Look

Television movies are shot on film for a number of reasons—some of which may not seem so rational in the abstract. Networks often specify whether a show is to be shot on tape or film. Usually the decision to have a show shot on film is based on aesthetic considerations more than anything else. Many people feel that there is a "film look" which is superior to a "tape look" for certain kinds of programming and that the two mediums have unique limitations which inevitably result in a different kind of image. Analyzing this notion is fairly tricky and the issue may seem too complex for working producers to bother debating. If the boss wants tape, shoot tape. If he wants film, shoot film.

Nonetheless the difference between a "film look" and a "tape look" is worth considering if the producer is free to choose his medium. For the most part "film look" vs "tape look" can be translated into "single camera vs multiple camera." What people tend to associate with videotape is a relatively flat lighting style that stems from a multiple camera shooting technique. (For further discussion of this see separate article on lighting for video in this issue.) Some people however feel there is a difference beyond a difference in studio lighting techniques. There are certain characteristics of a televised film image which differentiate it from an electronic image generated directly by an electronic camera. The 35mm film has a much greater resolving power and greater contrast range than the current standard video image. It might seem that the extra resolving power and contrast range are being thrown away when the image is transferred to tape for broadcast, but the net result is a subtle difference in the characteristics of the final image. Ironically some testing indicates that viewers consider a pure direct image to be "sharper" than a transfer from film to tape. This is a subjective judgment, and it is probably a reaction to more clearly defined edges in a pure tape image. In a film image any transition from a foreground object to a background is likely to be more gradual than it would be in a video image of the same subject (precisely because of the greater resolving power and contrast ratio of film). The net effect in comparison may be that a viewer considers the video to be more clearly delineated or "sharper" when in fact it is not (in any objective, measurable sense).

Perhaps the issue of a film look vs a tape look is best clarified by citing an extreme example. A television movie about the U.S. Olympic hockey team was made for ABC last year in which videotaped sequences of the actual hockey games were integrated with staged sequences involving actors. ABC wanted the movie shot on

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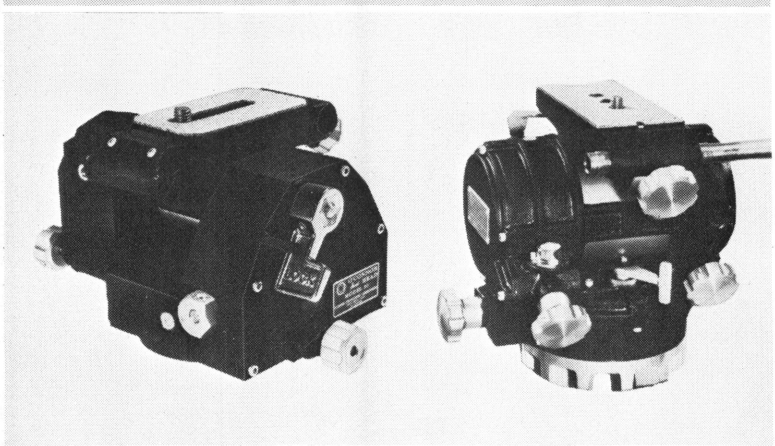

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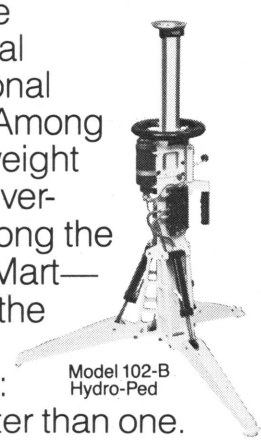

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film, but the decision was made to shoot on tape any scene to be directly intercut with scenes from the real hockey games. The look of the hockey sequences was matched so well that it was virtually impossible to distinguish what was staged and what was real. The rest of the movie consisted of a behind-the-scenes story revolving around the personal lives of the coach and several players. All of these scenes were shot and edited on film. The staged videotape sequences were edited with the videotapes of the games; and, when the time came to combine the two elements into one program, there was a debate about how to go about doing it. The production company recommended combining everything on tape since the final product was going to be put on tape and broadcast anyway. They suggested transferring the edited film sequences to tape and then editing them into a master tape along with the hockey sequences. Their reasoning was that this was the best way to minimize any loss of image quality. The network, however, insisted that the show be delivered entirely on film. The videotape sequences were to be transferred to film, and cut together with the negative for the behind-the-scenes sequences. A release print for the entire picture would be made and transferred to tape. Tests were done to compare the image quality on a television monitor for both procedures, and the network stuck by its decision even though the production company felt the image quality was substantially better in the videotape version. The explanation for the network's decision was that the videotape look had too much "immediacy", it felt to them too much like a live sports event rather than a movie. They preferred a degraded image which seemed more comparable to a documentary film than a live telecast.

What is apparent here is that there are certain image characteristics in video which are so strongly associated with live television that they seem to have more immediacy. The viewer does not feel as much distance between himself and the events. Normally one might think immediacy was something to be strived for in a dramatic program, but in this instance the network executives felt it worked against the overall impact of the show. A television movie is elevated in its stature by comparison to live television precisely because of the element of distance which goes along with a sense of the control the filmmakers have over what the viewers see.

It is extremely difficult to evaluate whether the subtle differences between pure tape images and film-to-tape transfers have the impact they do purely because of an association with particular

kinds of programming or whether the impact is an inevitable function of the psychological and physiological processes involved in perceiving the two images. If it is associational, it will diminish as videotape is used increasingly for dramatic programming. Most viewers have seen very few dramatic videotape productions that were lit for single camera so it is impossible to make a meaningful comparison.

In the process of refining the Panacam, Robert Gottschalk of Panavision had a test shot on a set at Warner Brothers to help determine the difference between a film look and a tape look. After the last setup for a series which was being shot on film, a video crew replaced the film camera with the Panacam and shot the same scene on tape without changing any of the lighting. The film was transferred to tape, and a comparison was made by viewing each on a television monitor. Gottschalk's own personal conclusion was that the difference between the two would not be discernible to the average viewer except that the purity of the color was better on the videotape original. Gottschalk has agreed to conduct a more thorough test of this sort with American Cinematographer, and the results will be published in a future issue.

Economic Considerations

For the producer trying to choose between film and tape aesthetic considerations may be less important than economic considerations—both with regard to the cost of the production itself and with regard to the exploitability of his end product. One of the major reasons for producing television programming on film has been the relative ease and economy of secondary distribution on film. Until recently, syndication and foreign sales of television programming were most feasible on film. Local television stations were much better equipped to handle 16mm films than videotapes, and the differences in the national standards for television systems around the world made foreign distribution of videotapes very awkward. Both of the situations have changed. Local stations have become increasingly able to use videotape (especially in the form of ¾" cassettes) and computers have made possible economic standards conversions for videotape. Moreover there is a trend developing in the non-theatrical and institutional distribution towards video cassettes rather than films.

Another major reason for producing television movies on film rather than tape is the fact that a television movie can sometimes be distributed theatrically abroad. If this is the case with a particular television movie, the producer will probably want to

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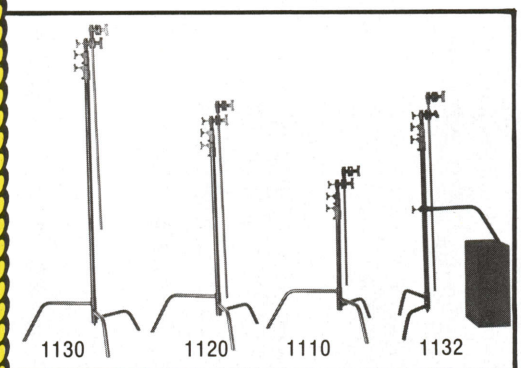

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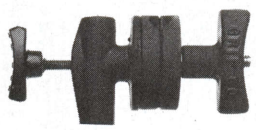
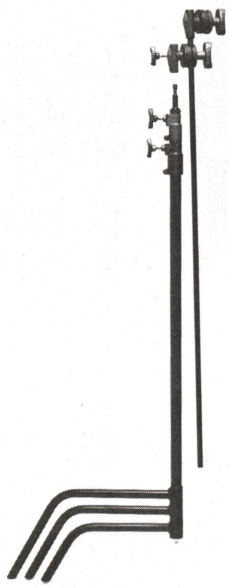
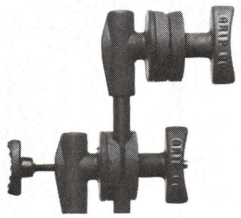


#1114–Extension arm only

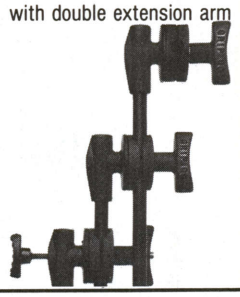
Stand folded, head removed



#1112–Grip head with single extension arm



#1113–Grip head with double extension arm



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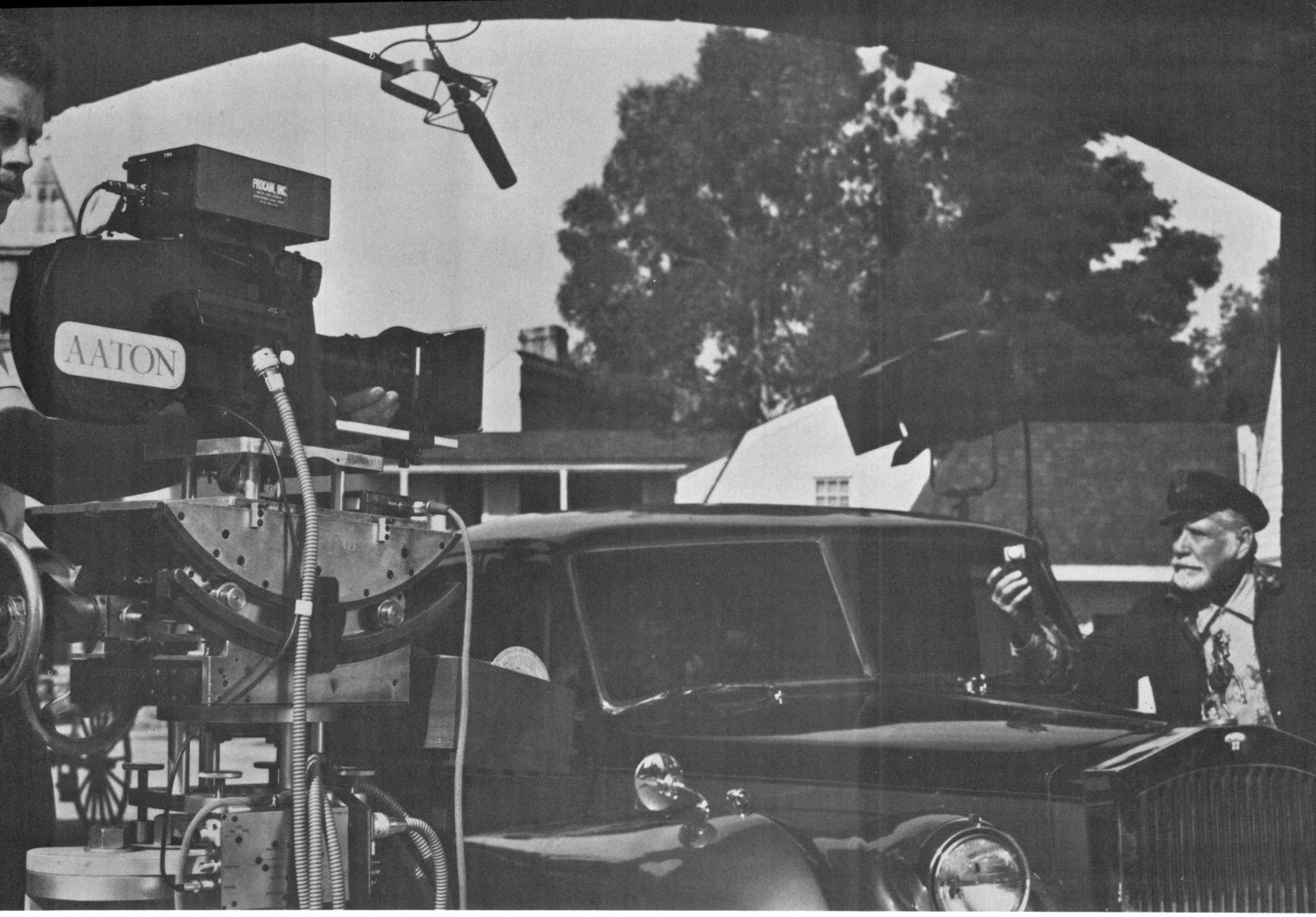

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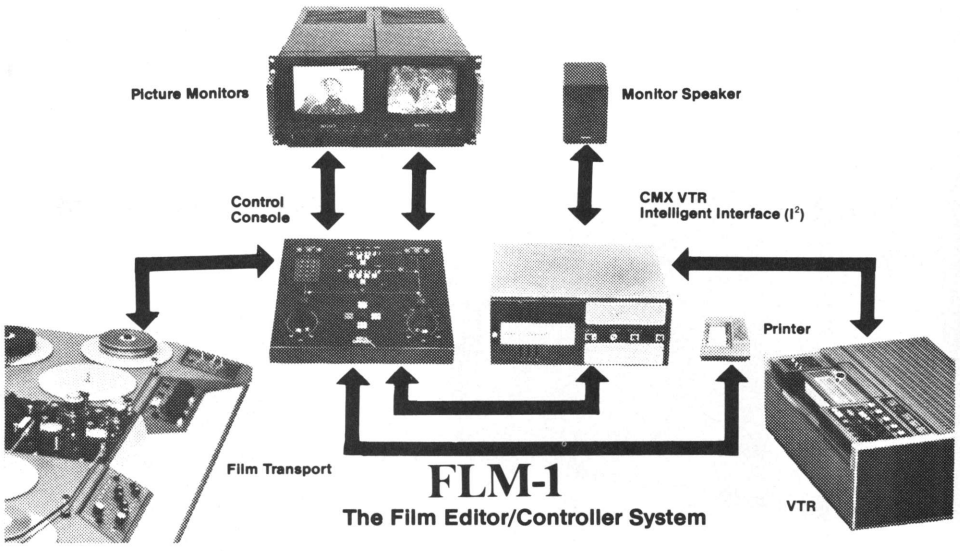
shoot on film. It should be noted, however, that the producer who shoots his movie on tape does have a means of producing 35mm release prints if he discovers an unexpected theatrical market. Tape-to-film transfers employing computerized image enhancement and sophisticated transfer techniques can result in 35mm prints which may be considered suitable for theatrical exhibition. This is a highly subjective judgment, however; and the producer considering this option would be well advised to view samples of tape-to-film transfers before making a decision to shoot on tape.

Another economic consideration which may play a role in the choice of film or tape as a production medium is the archival qualities of the medium. Much has been said recently about the cost or difficulty of preserving color movies, but videotape is an even less stable medium from an archival point of view. The principle problem with long term storage of magnetic tape is the loosening of the bond between the oxide and the base and the shedding of oxide which occurs when an old tape is played. Another problem is the rapidity with which electronic technology changes and progresses. Today's videotapes may be completely incompatible with the recorders of the future, in the same way that some early additive color processes in film are incompatible with standard projection equipment today. Digital technology seems to offer some hope of an archivally stable electronic image, but it is still dependent upon the physical characteristics of the medium on which it is stored.

It is generally assumed that a movie designed for theatrical exhibition via release prints is best shot on film. There is, however, an increasing amount of interest in shooting theatrical features on tape. Roger Corman's New World Pictures recently announced plans to shoot a feature on tape for theatrical exhibition. In the past there have been a few theatrical films shot on tape and transferred to film—most notably 200 MOTELS and NORMAN IS THAT YOU as well as stage shows such as GIVE 'EM HELL, HARRY. Corman described his venture as the first to use current state-of-the-art high definition video techniques, but he later decided to wait until the equipment had been more thoroughly tested and refined.

The reason Corman would consider shooting a feature on videotape rather than film is simply that by doing so he estimated that he could save as much as 60 per cent of the production costs due to savings in special effects. Electronic technology offers many ways of reducing production costs for certain kinds of produc-



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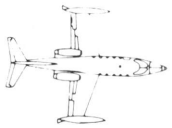

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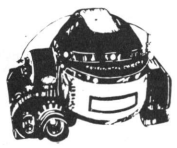

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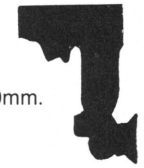

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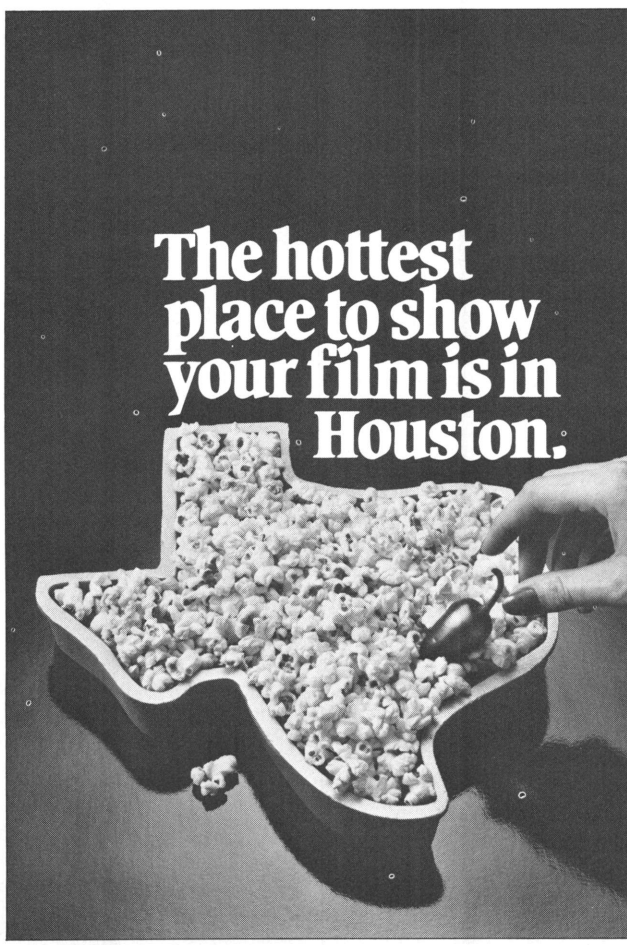

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tion. Electronic production equipment is more expensive to rent than film equipment, but this can be offset by saving in laboratory costs. Instead of raw stock, processing, workprints, negative cutting and an answer print, there is simply 1" or 2" master videotape ¾" cassettes dubbing off-line and on-line editing. The cost of off-line editing is greater than the same process on film, but the saving in opticals can be phenomenal. The ability to do travelling matte effects as well as virtually every other kind of optical by electronic means in a computer assisted editing session can greatly reduce post-production costs by making more feasible the use of miniatures and background shots.

Time Savings with Tape

In many instances the most significant advantage of tape is in the reduction of the time required to complete a production. This can be important either because of the timeliness of the subject matter or because of the reductions in labor costs that go along with a shorter schedule. The time saving generally comes in the post-production area, although the use of tape may influence the choice of a multiple camera approach to production thereby saving time there as well. It should be noted, however, that the set-up time for a video camera crew may be much greater than the set-up time for a comparable film crew. The lighting time will probably be the same, but aligning a video camera properly can be a much more time consuming process than threading up and inspecting a film camera. Also malfunctions in a video camera can be much more difficult to track down and correct. Computerized camera control units have greatly reduced set up and diagnostic times for video cameras, but there may still be more time devoted to camera set-up than with film.

The first area in which there is substantial time saving is the initial phase of post-production. There is no laboratory work required, though there may be some transfer time necessary if ¾" cassettes are not simultaneously recorded during the shooting. (For quality control reasons it is generally better to have the off-line editing cassettes made from the 1" production tapes rather than recorded simultaneously. Otherwise recording defects which may exist in the 1" master will not show up in the ¾" editing cassettes.) The off-line editing process itself may or may not be faster depending on how accustomed the editor is to video procedures. A film editor trying for the first time to do off-line videotape editing may find it to be a very frustrating and awkward way of working if he is accustomed to working on a Moviola. If he is accustomed to working on a flat bed the

transition to off-line video editing will be easier once he gets the hang of it. In fact he may never want to touch a piece of film again. Video editing virtually eliminates all of the physical handling of the material being edited. Art Schneider at CFI has conducted a comparison test for Universal in which he edited on tape while a film editor cut the same footage with film. His conclusion was that video cutting cuts the time required by 50 per cent.

The greatest way to reduce post-production time with video is, of course, to eliminate it altogether by shooting multiple camera and editing as you shoot. It is the ability to do this which attracts many producers to video production, but such production requires a great deal of pre-planning and inevitably cheats itself out of part of the creative process in editing. Another approach, which may be feasible depending on the subject matter, is to eliminate the off-line phase of the editing and go directly to on-line. This can result in a saving of time and money provided the director is prepared to commit himself to editing choices quickly.

Sound editing can now be accomplished as easily, if not more rapidly, in video if state-of-the-art facilities are available, and there is of course, no necessity for negative cutting, timing and making a first trial print. These are replaced by on-line editing. It should be noted in contrast to release printing that duplication of a master videotape is normally done in real time (i.e. it takes an hour to make a dupe of a one-hour tape). It is possible to make several duplicates simultaneously if there are enough videotape recorders available, (but this may not be the most cost efficient procedure.)

Ultimately the choice between film and tape may be a choice between maximum image quality in projection and maximum flexibility in production. The development of a high-definition television system will reduce the difference in image quality, but at present there can be no doubt that film offers the greatest potential for large screen images. Equally there can be no doubt that electronic technology and video production techniques have developed to the point where they rival or surpass film production techniques. The documentary cameraman headed up the Amazon River may still be significantly better off with a film camera, but it is a moot point whether ordinary location cinematography or controlled studio cinematography is any easier or more foolproof with film.

Combining Film and Tape

It is, of course, possible now to have the best of both worlds by using both film and tape techniques in the same production. If

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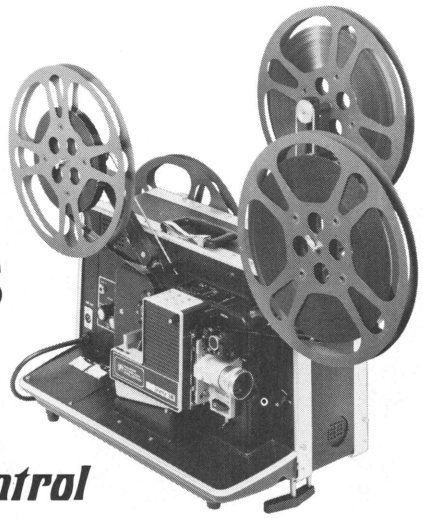

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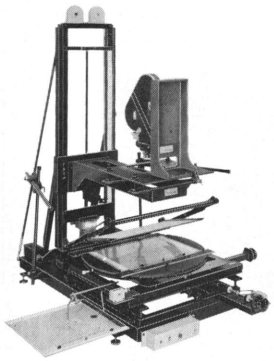

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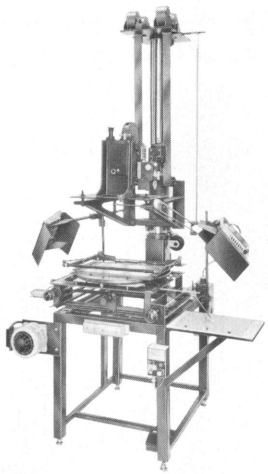

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one wants to shoot film, but likes the instant replay aspect of tape, there is video assisted photography in which a film camera is augmented by a video camera connected with monitors and a ¾" recorder. It is possible to derive the video image from the same lens as the film image thereby insuring exactly the same composition on tape and film. It is even possible to have the video assist produce a full-color image although a black and white image is more common.

Video assist enables anyone to see exactly what is being filmed during a take and to replay it immediately afterwards. (The only thing it does not show, of course, are defects caused by camera malfunctions or faulty stock.) The virtues of this can be debated, and some production managers would probably argue that it is counterproductive because it results in an excessive amount of time on the set being spent evaluating various takes. Nonetheless, for the producer and director who knows how to use it properly, a video assist can be a useful creative tool.

It is also possible to combine film production with video post-production in ways described elsewhere in this issue. Film can be shot and transferred uncut to videotape directly from the negative. The edited videotape can be used for broadcast and duplicated for distribution, or it can be used to facilitate negative cutting in order to produce a film release print. Videotape procedures can be used for sound post-production in an otherwise all film production.

The main thing that electronic technology offers the film producer is speed and flexibility. A special effect can be executed ten different ways in a matter of minutes. A production can be distributed the day after it is shot. A sound effect can be auditioned in sync with picture and up to 21 other tracks of sync dialogue effects and music in the same time it takes normally just to audition the effect. A first cut can be radically re-edited without undoing the first cut. Creative freedom is often a function of speed of execution. The faster it is possible to work, the more time there is for experimentation.

Traditionally electronic production techniques have emphasized speed for the sake of economy and timeliness. Now the trend is towards the development of electronic techniques which are designed for creative luxury rather than economy. For the meticulous craftsman with a limited budget and no deadlines, film still offers the most economical means of production. For the television producer who can afford state-of-the-art facilities, electronic technology offers maximum speed and creative flexibility. ■

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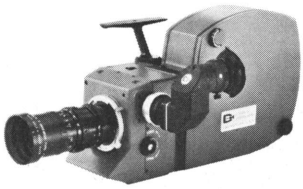

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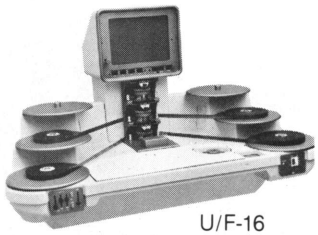

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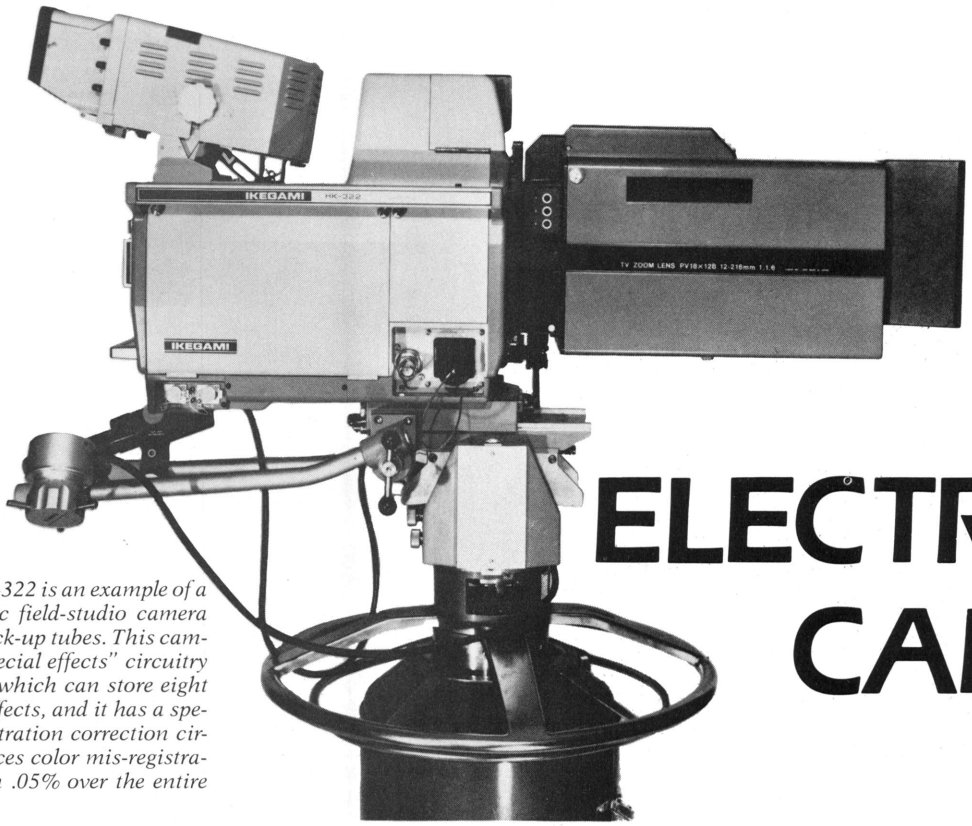


The Ikegami HK-322 is an example of a totally automatic field-studio camera using three 1" pick-up tubes. This camera includes "special effects" circuitry with a memory which can store eight pre-set special effects, and it has a special digital registration correction circuit which reduces color mis-registration to less than .05% over the entire raster.

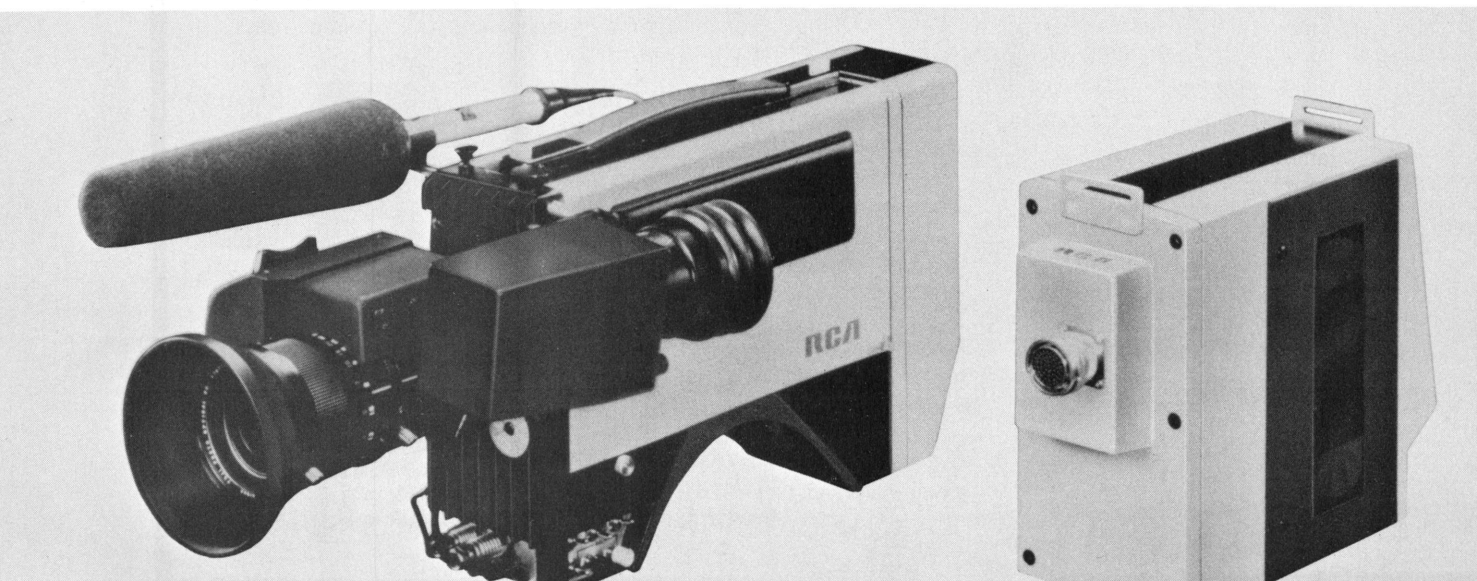
THE ELECTRONIC CAMERA

By RICK WILSON

The development of the electronic camera is a phenomenon which is viewed by film cameramen with a variety of reactions ranging from excitement to disinterest to skepticism or fear. Because it grew out of a medium which at first seemed at odds with the theatrical motion picture, many cameramen have assumed that the electronic camera was a gadget that had no relevance to their craft. The time has come, however, when every cameraman has to acknowledge that the electronic camera is rapidly becoming just as valid a tool for his craft as the film camera. This is not to say that an electronic camera can do everything that a film camera can do. There is no such thing as a high speed video camera capable of doing the kind of motion analysis a high speed film camera can do. Nor is there any way to accomplish what a variable shutter can do on a film camera. Nonetheless there are many jobs for which an electronic camera is as good as if not better than a film camera.

The basic difference between photographic and electronic recording of moving images is that a film frame is captured all at once while the image for a video frame is recorded sequentially by means of scan lines. In an electronic camera the image is focused on a photoconductive surface (i.e. a surface composed of something whose ability to conduct electricity varies with the amount of light hitting it) instead of the surface of the film. The photoconductive surface is then scanned with an electron beam in such a way that the brightness of the image at any given point is translated into the amplitude of an electrical signal at a corresponding point in time.

The RCA Hawkeye camera has a detachable in-camera ½" VHS cassette recorder capable of recording 20 minutes per cassette. The camera with the recorder, a microphone and batteries weighs 23 pounds and is capable of delivering a broadcast quality image. It is part of an entire recording and editing system to be described in a future issue.



Generally in order to record a color image, a video camera must split the full color image into three components. This is accomplished by means of a beam splitting prism or by dichroic mirrors, and three pick-up tubes record the red, green and blue images separately. The signals generated by these three images are then amplified and combined into one composite signal which can be recorded on magnetic tape.

Lenses

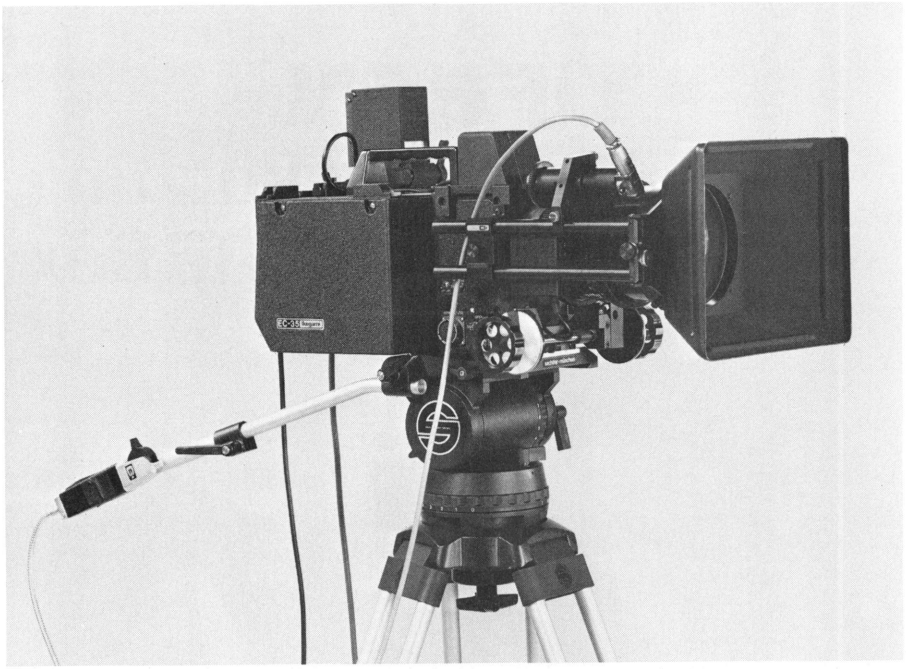
In the early days of television video cameras used standard 35mm format fixed focal length lenses mounted on a rotating turret. With the advent of zoom lenses, fixed focal length lenses were abandoned; and a zoom lens became an integral part of the camera. As electronic cameras became more sophisticated and compact, they were designed to accept interchangeable lenses from a variety of manufacturers. Angenieux, Schneider, Canon and Fujinon are among the principal manufacturers of lenses for video cameras. Although there has recently been some interest again in the use of fixed focal length lenses on video cameras, zoom lenses are the norm, and they are available with zoom ranges from 6 to 1 all the way up to 42 to 1. Often zoom lenses for video cameras are designed as a system with modular accessory packages including range extenders, close-up adapters, retrozooms, wide angle attachments or tele attachments. They are usually servo controlled or motorized, and the speed of the basic lens is normally fl.6 to f2.

The field of view for a lens on an electronic camera using ⅔" pick-up tubes is narrower than the field of view for the same focal length lens on a 35mm motion picture camera. A 10mm lens on a ⅔" video camera has the same field of view as a 24mm lens on a 35mm film camera, a 24mm the same as a 55mm, a 35mm the same as an 85mm, etc.

Beam Splitter

The beam splitter in a sophisticated electronic camera is a prism assembly. Some less expensive electronic cameras use dichroic mirrors. As a rule accurate registration and color control is more difficult to achieve with dichroic mirrors than with prism assemblies. The design and manufacturing of the prism block, along with its maintenance, is one of the most crucial factors affecting the image quality obtainable with the camera.

It should be noted that there are some color electronic cameras which do not require a beam splitter because they have a single pick-up tube which is capable of separating the red, blue and green components of an image internally. The Sony Trinicon tube is one example of such a tube, and the Hitachi FP-10 and the JVC S-100 are single tube cameras. At present these cameras do not yield an image considered to be "broadcast quality" and they are used primarily for industrial or semi-professional productions. It may not be long, however, before a single tube camera is developed which is competitive with a three tube camera.

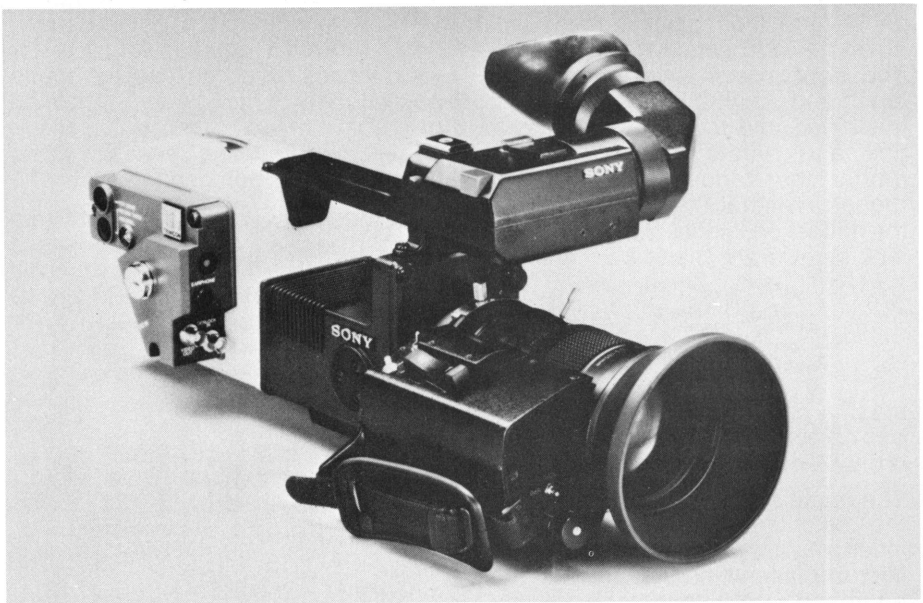


The Ikegami EC-35, designed in response to the demand for a "film style" electronic camera, will be the subject of an in-depth report in an upcoming issue. It accepts interchangeable T1.5 Canon prime lenses as well as zoom lenses, and it contains a "knee compression circuit" to duplicate the look of a film image in highlight areas. Cinema Products, the Western States distributor for the camera, has been chosen to design a full range of accessories for the EC-35 including the matte box, the follow focus mechanism, and the adaptation of the Academy Award winning J-4 zoom control shown on the camera here.

Pick-up Tube

The heart of the electronic camera is the pick-up tube or tubes which convert the optical image into an electrical signal. Pick-up tubes vary in size and in the makeup of the photoconductor. To some extent the size of the pick-up tube is comparable to the width of the film used in a

The Sony BVP-110 is a broadcast quality single tube ENG camera which weighs approximately six pounds without lens and requires only 9W of power. The patented High Band Saticon Trinicon tube is capable of a horizontal resolution of 400 TV lines.



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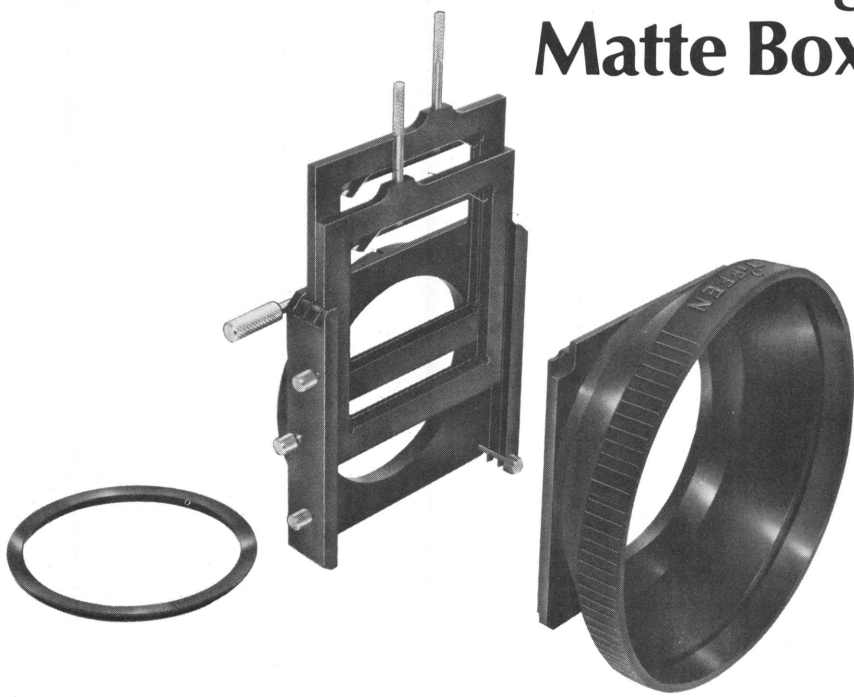

The Tiffen Universal Rotating Matte Box gives you the opportunity to hold three filters with a collapsible rubber lens shade on all of your lenses.

The Universal Matte Box consists of five parts; the rotating body assembly, two filter frames for holding 3x3 inch filters, the front mount with the rubber lens shade, and a Series 9 insert ring.

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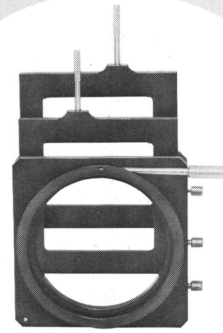

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film camera (assuming that the signal generated by the camera is not being degraded during recording onto videotape). Electronic cameras designed exclusively for studio use may use a pick-up tube having a diameter of 1¼" or 30mm. Other cameras may have 1" (25mm) or ⅔" (17.7mm) pick-up tubes. The smaller the diameter of the tube the more difficult it is to design and manufacture it to achieve the same image quality, but ⅔" tubes are now standard for "field" cameras and produce excellent images. Until recently ⅔" tube cameras were considered roughly comparable to 16mm film cameras, 1¼" cameras to 35mm cameras and 1" cameras to something in between; but now ⅔" tubes are used in studio cameras as well as all field cameras. Today the video equivalent of shooting 16mm film is more likely to be considered the use of a ⅔" camera with a ¾" videotape recorder and the equivalent of 35mm the use of a ⅔" camera with a 1" or 2" videotape recorder. Any comparison of pick-up tube diameter to film gauge is misleading, however, because a larger film gauge is automatically capable of greater resolution while the limitation of resolution with an electronic camera is a function of the number of scan lines in the image and the processing of the electrical signal as well as the size of the target area in the pick-up tube.

Pick-up tubes are classified according to the photoconductor which is used; and, since the development of specific photoconductors are generally proprietary processes, the different kinds of pick-up tubes are known by their trademark names, such as Plumbicon, Saticon, Chalnicon, Leddicon, Newvicon, etc. Strictly speaking all of these tubes are "vidicon" tubes as opposed to the "image orthicon" design originally used in television cameras, but in the vernacular "vidicon" now connotes the lower quality tubes used in closed circuit and semiprofessional equipment. A revolution occurred in color electronic cinematography when Philips developed a vidicon tube using lead monoxide as the photoconductor. The tube was dubbed a Plumbicon tube after the Latin word for lead (Plumbum) and was the undisputed standard for many years. More recently other photoconductors have been developed and in particular the Saticon tube from Hitachi offers performance characteristics which are competitive with the Plumbicon tubes. Most sophisticated electronic cameras are designed to accept either Plumbicon or Saticon tubes, and the choice may depend on the use for which the camera is intended or simply the cameraman's preference.

Another improvement in the design of

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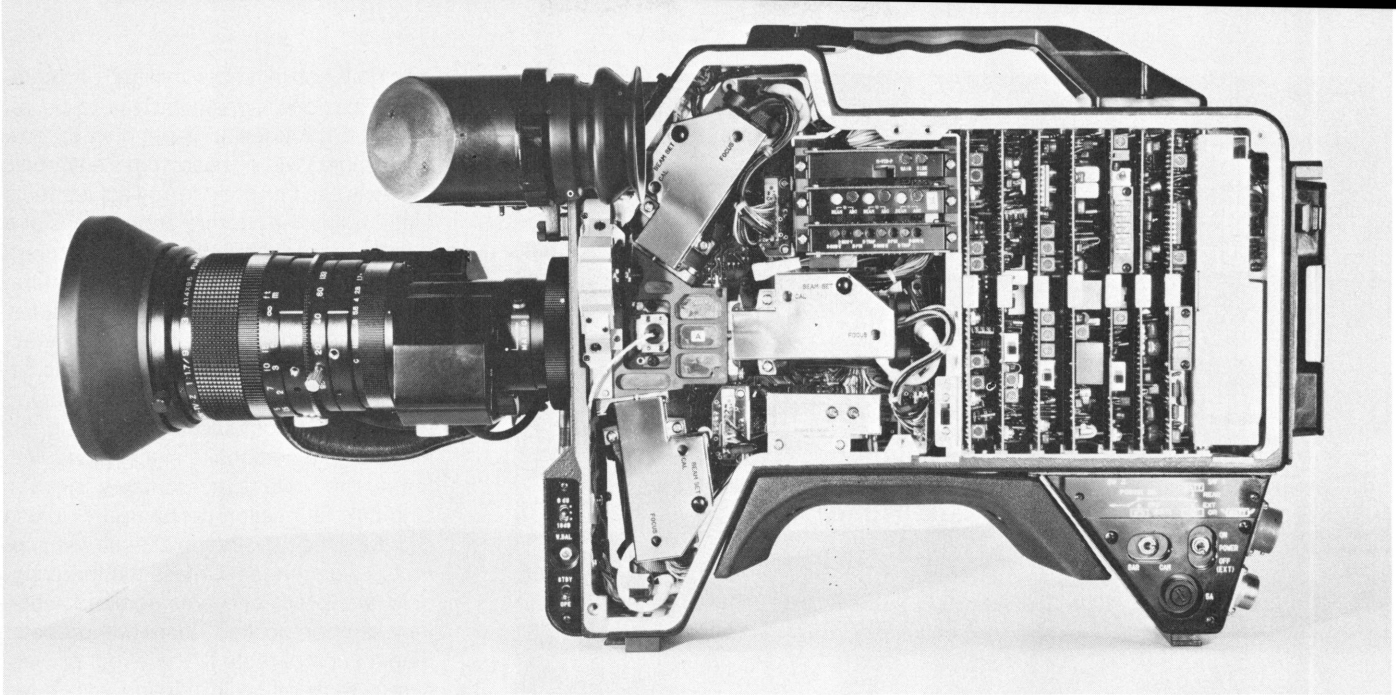

Yes, but how do you thread it? The side panels have been removed from this Ikegami HL-79D portable production camera permitting us to see exactly how it works. Since one picture is worth a thousand words, we need say no more. The HL-79D is an example of a sophisticated portable camera with a shoulder mount and ocular viewfinder which can be adapted to a variety of other configurations with larger viewfinders and different types of remote control systems.

pick-up tubes is the development of the "diode gun." The diode gun (as opposed to the triode gun in previous tube designs) is essentially an improved method of focusing the electron beam on the photoconductive faceplate of the tube. It results in greater resolution of the image, but not every camera will accept a diode gun tube since it requires a different voltage. Some cameras are now designed to accommodate either kind of tube and other cameras can be modified to take diode gun tubes.

Electronics and Controls

Between the pick-up tubes and the outlet for the cable which transmits the composite video signal from the camera, there are several electronic subsystems. Essentially the three signals coming from the

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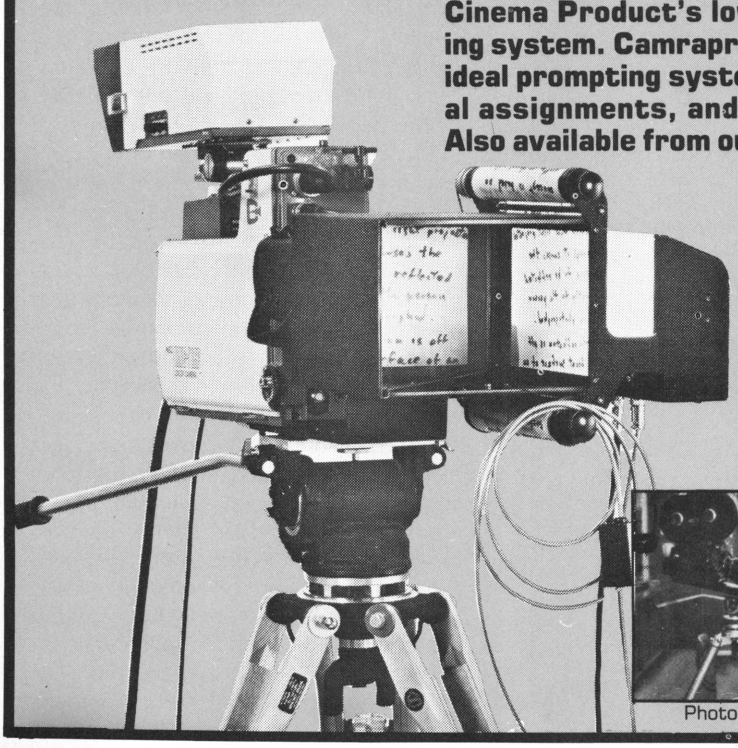

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pick-up tubes must be amplified and combined into one signal which is to be recorded or broadcast. Depending on how the camera is being used, these electronic systems can be controlled by adjustments made within the camera or by means of a remote camera control unit. If the camera is a sophisticated professional camera, there will probably be a variety of special circuits designed to improve the characteristics of the image in addition to the circuits required to control the scanning process and combine the three signals into a single composite signal along with the appropriate synchronizing signals. One critical function performed by these circuits is the registration of the three separate color images. Unless the three signals are precisely synchronized when they are composited, there will be color fringing comparable to the effect of inaccurate registration in printing with three colors of ink (i.e. the way the Sunday comics look when the printer did a sloppy job).

ENG/EFP/ESP

Electronic cameras can be classified according to the usage for which they are designed. Broadly speaking a distinction can be made between Electronic News Gathering (ENG), Electronic Field Production (EFP) and Electronic Studio Production (ESP). Each of these areas of production has its own requirements in terms of the performance, physical characteristics and cost of the camera, but classifying cameras as ENG or EFP or ESP cameras is not a simple matter because many cameras are designed to be used in different configurations for different kinds of production. The distinction between a top of the line ENG camera and EFP camera is really more a matter of how the camera is being used than of any inherent difference in the design or construction of the camera. A distinction is also made between broadcast and non-broadcast usage, but this can also be misleading if one assumes that all non-broadcast productions require lower performance standards in equipment. There are many non-broadcast uses for electronic cameras that have just as stringent requirements for the equipment as any network production. There is, of course, a large area of industrial, educational and semi-professional production which does have lower standards than most production intended for broadcast. Such productions are more likely to be recorded on ¾" or ½" videotape as opposed to 1" or 2" tape and the image quality of which the recorder is capable does not justify the cost of more sophisticated camera equipment. Appropriate cameras for this type of work would

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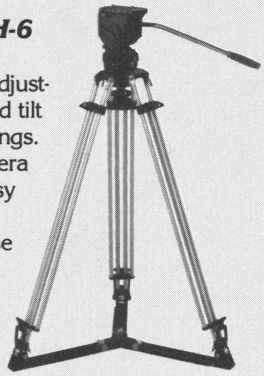

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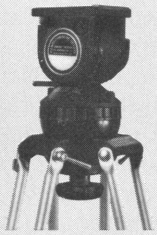

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include single tube color cameras and some three tube color cameras with dichroic mirror beam splitters. These cameras are designed to be handheld or mounted on a tripod. While they are not capable of the same image quality as ENG cameras, they are professional cameras and should not be confused with even less sophisticated amateur cameras.

ENG cameras have virtually replaced 16mm film cameras for television news location work and have a wide range of professional use. They are designed for portability and ease of operation, and they can be very sophisticated and expensive. Often they are used by a two man crew in conjunction with a portable videotape recorder. They generally have a shoulder mount and an eyepiece for the viewfinder monitor.

The difference between an ENG camera and an EFP camera is usually simply a matter of putting a larger studio type viewfinder on the camera, mounting it on a tripod or dolly, and plugging it into a remote camera control unit. The remote control unit permits adjustments to the circuits in the camera by turning knobs rather than having to use a screwdriver inside the camera. A remote camera control unit is generally only necessary when the camera has to be adjusted to match another camera being used simultaneously or when the conditions of the production are such that the camera would require frequent adjustment. In some cameras this control unit can be over a mile away from the camera, and under certain conditions the cable connecting the camera to the control unit can be replaced by a microwave link.

The distinction between top of the line EFP cameras and ESP cameras is also not a clear distinction since many EFP cameras are designed to be convertible to studio cameras. There are some studio cameras, however, which are designed purely for use in the studio and would never be taken into the field. Among these are cameras using 1¼" pick-up tubes and offering the maximum possible image quality obtainable with an electronic camera. These cameras can be quite bulky and are the most expensive cameras made.

Performance Specifications

The performance of an electronic camera is indicated by a host of specifications which may not necessarily be expressed in terms which permit comparison from one brand to another. Among the parameters affecting the performance in an electronic camera are sensitivity, resolution, registration, and image retention. The

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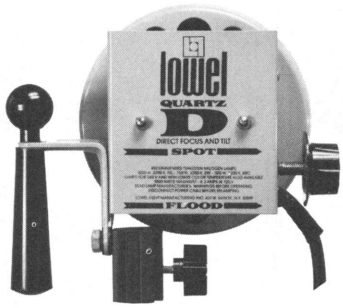

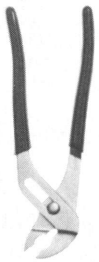

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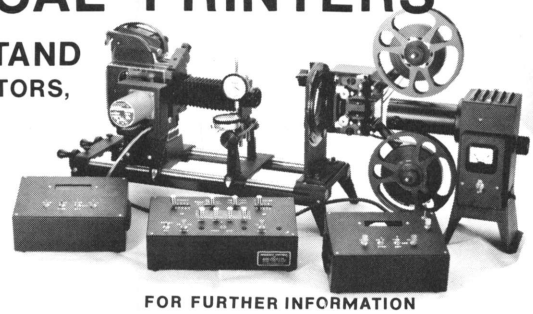

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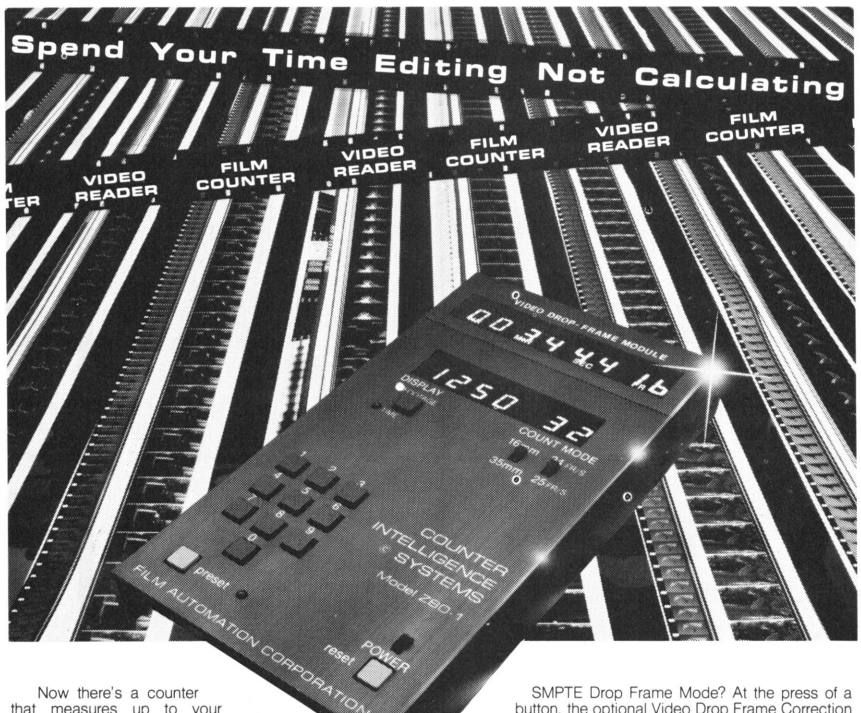

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performance of a camera under static test conditions is often quite different from its performance under actual shooting conditions, so that spec sheets are really no substitute for testing a camera in the field in order to evaluate its performance.

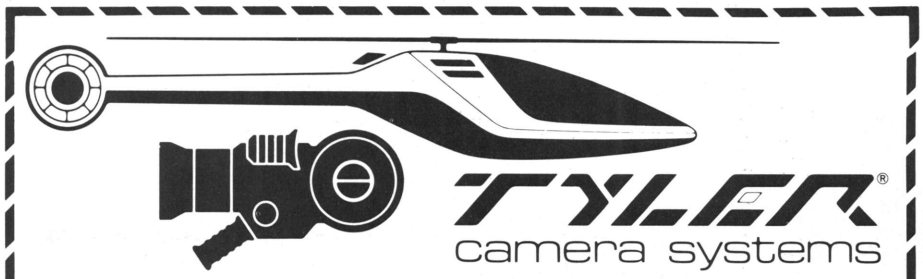
The sensitivity of an electronic camera is, of course, affected by the speed of the lens, but it is basically a function of the camera's internal optics, its pick-up tubes and its pre-amps. It is generally expressed in terms of the amount of illumination required at a specified f-stop to produce a signal with a specified signal to noise ratio. The best cameras available today have signal to noise ratios between 52 and 56 db. The higher the number of the "quieter" the camera. Noise in an electronic image is comparable to grain in a photographic image. As the gain is increased on the amplifiers for an electronic camera, the noise increases in a way comparable to the increase in grain resulting from forced development of film. Most electronic cameras are designed to function most efficiently at 125 to 150 footcandles, but most can yield good images at much lower light levels; and some claim to be able to produce acceptable images with as little as 2 fc of illumination.

Resolution in an electronic camera is primarily a function of the pick-up tube and electronics rather than the lens or the internal optics since the optical elements are capable of far greater resolution than the tubes. Discussions of resolution in an electronic camera can be confusing to film technicians because of the terminology employed. The resolving power of an electronic camera is expressed as the number of lines that can be resolved in a given area of the image, "TV lines" as they are called should not be confused with the lines per millimeter used to express the resolving power of film. The vertical resolution of an electronic image is limited by the number of horizontal scan lines making up the image. The horizontal resolving power of an electronic camera, however, varies according to how good the performance of the camera is. The best studio cameras with 1¼" pick-up tubes are capable of resolving 800 lines within an area of the image which is as wide as the image is high. With the NTSC system used in the U.S. there are 525 total scan lines of which 490 are actually used in the picture, so that a camera must have a resolving power of at least 490 lines if its horizontal resolution is to be equal to its vertical resolution. Cameras using 1" pick-up tubes can generally resolve 500 to 700 lines and good cameras with 2/3" tubes have a resolution in the 400 to 650 range. At present single tube cameras generally have a resolution of less than 300 lines.

Registration in an electronic camera refers to its ability to accurately synchronize the signals from the three separate tubes so the three images are combined in proper registration. It is measured with a test chart which can reveal how far the red and blue images diverge from the green. Accuracy of registration is a function of how sophisticated the electronics in the camera are, and depending on the camera, it can be vulnerable to temperature changes. Most sophisticated electronic cameras now include some form of automatic registration adjustment to reduce the amount of time required to set up a camera at the beginning of a shoot.

Image retention effects such as lag or comet tailing are problems which are inherent in the design of the pick-up tube, and the ability of an electronic camera to overcome these problems is again a function of the sophistication of its electronics. Lag refers to the tendency of an image to "stick" on the pick-up tube after the optical image has been removed. It is a function of how fast the photoconductor reacts to changes in the light hitting it and is most severe with very intense highlights. The photoconductor in the pick-up tube has a tendency to retain an image in a way comparable to the way the eye retains a very bright image. The net result can be lag, where a static highlight carries over from one frame to the next or comet tailing in which a highlight moving across the frame leaves a trail behind it. Over the years the design of pick-up tubes has improved and various correcting circuits have been developed to minimize these effects. A beam optimization circuit is one such circuit. Nonetheless lag and comet tailing can still be measurable defects in an electronic image, and they can affect the clarity of the color if there is a difference in the characteristics of the separate color signals.

The design of electronic cameras is changing so fast that it is difficult to predict what cameras being made in a few years will be like. The Ikegami EC-35 and the Panacam are indications of one direction in which electronic camera design is headed. Another is reflected in cameras being developed by Sony and RCA which are designed to house a ½" videocassette recorder in the camera body making it a completely self-contained unit. The emergence of digital technology has made possible a digital camera, and there is a good bit of work being done in solid state cameras in which the pick-up tube will be replaced by a solid state sensor. Another development on the horizon is high definition television with cameras capable of a resolving power comparable to film. ■



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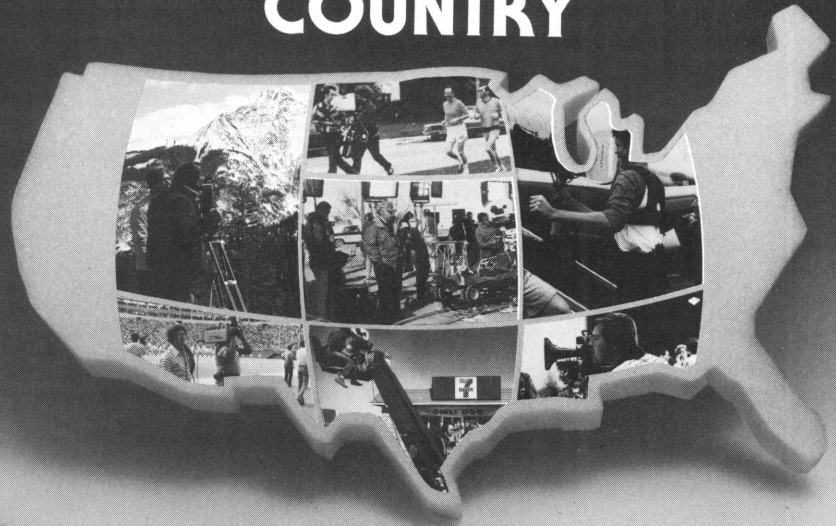

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THE VIDEO CREW

A color monitor on the set enables a crew from Sunrise Canyon Video to check the composition of a crane shot.

Video crews come in all shapes and sizes just like film crews. They can be as small as one or two people and as large as the biggest film crew. On a large video crew most of the personnel are performing exactly the same functions they perform on a film crew. Grips, gaffers, art directors, prop men, sound men, greensmen, drivers, painters, etc. do basically the same job whether the production is being recorded on film or videotape. There are some members of a video crew of course whose jobs differ from their counterparts in a film production. As more and more productions are shot on videotape, personnel who are accustomed to working on film productions will want to be able to work on video crews as well, and a brief survey of some of the crew functions which are different with video may help to pave the way for this transition.

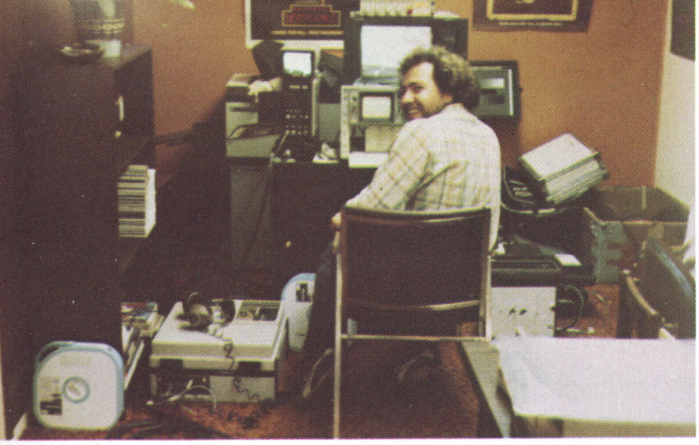
Lighting Director

As a rule video productions have a lighting director instead of a director of photography. The lighting director is responsible for designing and executing the lighting, but he does not set the composition of the shots in the way a director of photography does. In a video production the director generally works directly with the camera operator in setting the shots. There is no reason of course that a director of photography accustomed to working with film could not work on a video production in exactly the same way he does on a film production. Many lighting directors have backgrounds as film cameramen and the cameraman's union in Hollywood no longer distinguishes between directors of photography for film and for tape. Other lighting directors on video productions have backgrounds as lighting designers for stage productions or as gaffers. A lighting director on a video production may be more experienced in the use of lighting grids which are wired through a central dimmer or more accustomed to lighting for multiple cameras, while a director of photography on a film crew may be more experienced in the use of floor units and lighting for single camera photography. A lighting director in video may be accustomed to using floor plans of a set to plan his lighting and less accustomed to lighting through the lens.

Technical Director

The technical director on a video crew coordinates the camera crew and the videotape recording crew. Although his responsibilities are primarily logistical and technical, he may become involved with the director in the creative process. If the production is a multiple camera show being edited live, the technical director oper-

Minimum crew requirements for broadcast quality video. This shot is actually being recorded on 1" tape. Some ¾" recorders which are even more compact can also produce broadcast quality images.



(LEFT) The video man for a crew from Excalibur on a location shoot has set up shop in someone's study. The 1" videotape recorder is on the floor beside him. (RIGHT) A production crew from Compact Video is using two cameras mounted on tripods for this location exterior. The second camerman is just visible in the right foreground.

ates the video switching console which performs the editing functions. In general he is responsible for overseeing the set-up of the video cameras and recorders and for insuring that the director's decisions about compositions and camera movement are executed as efficiently as possible. He has no direct counterpart on a film production. To some extent he assumes some of the responsibilities of a director of photography as the principal coordinator of the activities of the crew. If the show is edited live, he is of course functioning like the film editor. He is not necessarily a video engineer although he must understand the needs and responsibilities of the video engineer.

Video Man

The video man is responsible for processing the video signal as it is recorded. His function is really comparable to that of the timer and lab contact for a film production. He adjusts the brightness and contrast and color balance of the image. He is also responsible for insuring that the cameras are properly registered and that the color balance of the signals from multiple cameras is consistent. He does his job by means of remote camera control units, using a monitor, a wave form monitor and a vectorscope. He is the one who sets the f-stop on the camera—using the waveform monitor to make sure the signal has the proper "white level." He will advise the lighting director if the brightness range of a scene is too great or if the overall light level is too low. He balances the color by having the cameraman frame up on a white or gray card and setting the gains for the red, blue and green components of the signal. He can boost the overall gain of the video signal in order to compensate for extremely low light levels in a way comparable to force developing film. He may be an engineer; and on a small crew he will probably be the maintenance man for the video equipment as well. Many sophisticated electronic cameras are sufficiently automated to be operated in the field without the attention of a video man, but normally this is only done with an ENG shoot using a one or two man crew. It is also possible for the video man not to be an engineer capable of doing maintenance on the equipment, but still sufficiently versed in video technology to properly adjust the signal for recording.

Videotape Machine Operator

The video tape machine operator does just that. In a sense he is comparable to the second assistant cameraman since he is the person loading the tape onto the machine and keeping track of what has been recorded on a given reel of tape. He is also comparable to the sound recordist since the sound is probably being recorded on the videotape as well—unless the production is using a multi-track audio recording machine in which case the crew will include an audio tape machine operator as well. The videotape machine operator can also be compared to a laboratory technician on a film production since he is operating the machinery which processes the image.

Script Clerk/Production Assistant

Although the script clerk on a video crew performs essentially the same function as the script clerk on a film crew, he is more accustomed to the procedures of logging and timing shots recorded on videotape and probably less involved in supervising the continuity of the action. A script clerk or production assistant who has logged and timed the shots in a video production will probably participate in the on-line editing—especially if there has been no off-line editing.

Production Management

Because videotape is associated with productions which are more akin to live stage productions than traditional film productions, the production management personnel tend to have different titles and slightly different responsibilities. Instead of having a production manager, 1st assistant director and 2nd assistant director a video crew will have an associate director and a stage manager. Many of the tasks normally performed by a production manager will be done by an associate producer. The differences reflected in these job titles stem more from the differences in staging and scheduling procedures and the differences in talent contracts relating to videotape productions than any technical requirements associated with videotape recording. If one were shooting a dramatic feature for theatrical exhibition on videotape, the production management personnel would be exactly the same as a feature film production.

Crew Size

It is possible to shoot video with a one man crew using an ENG camera and a portable ¾" or 1" videotape recorder. It is even possible to mount a microphone on the camera to record sound simultaneously. Most ENG work is done with at least two men, however: a lighting cameraman and a soundman/tape machine operator. The next step up is a three man crew including a camera operator, audio operator, and an engineer/maintenance man. To this must be added any grips or gaffers. If multiple cameras are used, there will be a technical director. Larger crews are essentially the same as a film crew except that there is no second assistant cameraman and there must be a video man and a technical director. One video man can usually handle multiple cameras, and the decision as to whether to have an assistant cameraman for every camera is essentially the same as it is with a film crew. ■

HIGH DEFINITION TELEVISION

A revolutionary new television system with an image sharpness comparable to 35mm film is being developed for theatrical as well as home use.

At present the two greatest limitations of electronic cinematography in comparison to traditional motion picture photography are the contrast range and the sharpness of the image. The development of High Definition Television (HD-TV) represents an attempt to increase the sharpness of the electronic image to a point where it is comparable to 35mm film. Work on HD-TV systems is being conducted by various groups in many different countries. In the U.S. The Society of Motion Picture and Television Engineers (SMPTE) recently sponsored a study group as a preliminary step towards establishing standards for HD-TV.

By far the greatest amount of work on HD-TV has been done in Japan by NHK (Japan Broadcasting Corporation), and NHK has developed a workable system for HD-TV, and three Japanese manufacturers (Sony, Panasonic and Ikegami) have produced prototype equipment for the system. Recently CBS sponsored a series of demonstrations of the NHK HD-TV system in Los Angeles, New York and Washington. Included in the demonstration were high definition video tapes of programs produced with the prototype equipment. There were selected highlights from the Rose Bowl Parade and the Rams-Redskins football game as well as scenes from an episode of THE FALL GUY and two short subjects produced by Zoetrope Studios. The demonstrations have been hailed by some as a landmark event in the history of television comparable to the introduction of talking pictures or color television. By any standard it was an impressive demonstration, and it seems inevitable that high definition television will become commercially available in the very near future.

Image Sharpness

The apparent sharpness of an image is a function of several factors,

An image photographed directly from the screen of the 30" HD-TV monitor built by NHK of Tokyo. The image is composed of 1125 scan lines and has an aspect ratio of 5:3. NHK has pioneered the development of a workable high definition television system which is currently being demonstrated in the U.S.

Prototype high definition television equipment from Sony designed for the NHK 1125 line system includes a camera, a 1" videotape recorder with full editing capability, a time base corrector, a monitor and 100" projector. The HD-TV image on the Sony projector with stereophonic sound was undoubtedly the most impressive facet of the NHK/CBS demonstrations held recently in Los Angeles, New York and Washington.

the most important being the definition of the image. Brightness, contrast, and viewing conditions can affect the viewer's sense of the "sharpness" of the images, but the key ingredient is the definition or the resolving power of the recording medium which can be measured quantitatively.

The principal limiting factor in the definition of an electronic image is the number of scan lines in a given frame, and the general consensus is that an electronic image having 1200 to 1500 scan lines would be the equivalent of a 35mm image. It should be noted of course that the definition of a 35mm image depends on the film emulsion and may improve as emulsions improve. The definition of a 16mm image today is as good as the definition of a 35mm image was ten years ago, and it is conceivable that the definition possible with film could continue to improve. The trend at present seems to be towards increasing the speed of an emulsion rather than the definition, however; and it should be noted that there is a point beyond which increased definition becomes unnoticeable for the viewer. NHK conducted a series of experiments which indicated that the viewers' impression of the sharpness of a scanned image increased until the image had 1600 lines. Beyond that point the improved definition of the image did not seem to be discernible given the viewing parameters for the test.

The NHK HD-TV system currently being demonstrated has 1125 scan lines with 30 frames per second and a 2:1 interlace of the scan lines (i.e. each frame consists of two fields having 562½ scan lines each). The SMPTE study group suggested a short term goal of 1100 scan lines but suggested that the ultimate goal should be a system with 1500 scan lines. Some of NHK's own research has indicated that 1500 lines are required for an HD-TV system using a 2:1 interlace. Other tests they have conducted indicated that 1100 scan lines could produce an image comparable to 35mm motion picture print film but that 1500 lines were required to produce an image comparable to a 35mm color transparency.

A viewer's impression of the sharpness of an image depends on the size of the image and the distance from which it is viewed. Everyone agrees that a large image viewed from a greater distance has more impact than a small image viewed closer up, and the idea of high definition television usually involves the goal of large screens. It also involves the goal of a wide screen format. Many proposals for high definition television suggest an aspect ratio of 2:1 although aspect ratios ranging from 1.67:1 to 2.67:1 have been proposed.

The SMPTE study group suggested a 2:1 aspect ratio, but the NHK system involves a 5:3 or (1.67:1) aspect ratio. NHK has conducted a series of experi-

(LEFT) NHK developed an HD-TV videotape recorder by modifying a conventional 1" VTR so that the recording head rotated twice as fast and the tape travelled at four times normal speed. (RIGHT) The NHK HD-TV camera uses special 1" pick-up tubes developed especially for the system. Both Sony and Ikegami have produced similar HD-TV cameras which were used for the demonstrations.

A NOTE ON BANDWIDTH

A newcomer to video and electronic technology can't get very far into the literature in the field without repeatedly stumbling over the term "bandwidth"— whether in specifications for equipment or in theoretical discussions. It may be helpful here to explain in layman's terms exactly what is meant by bandwidth and what its significance is in designing or using equipment.

An electronic image is the translation of a visual field (or a two dimensioinal optical image) into an electrical signal. This is accomplished by breaking the image down into a series of lines which can be scanned one after the other. The brightness of the image at any point is converted into a voltage level in an electrical signal. As the brightness varies from one point on a scan line to another, the voltage of the signal changes accordingly. Thus a single frame of the image is translated into changes in the voltage of an electrical signal during the time it takes to scan the complete image. The amount of detail that can be captured in the electronic image is then a function of how quickly the voltage of the signal can change from one level to another.

The rate of change in the voltage of an electrical signal is measured with reference to a frequency or the number of cycles a constantly pulsating signal would have in one second. The higher the frequency response, i.e. the higher the rate of change of which the signal is capable, the finer the detail it will be able to render in the image when it is reproduced on a screen.

Since a visual image is composed of a wide range of tones and shapes, the rate of change for the voltage during any given scan line may vary considerably. The range of this variation is the bandwidth of the signal. (So far we are talking only about brightness and not about color, so the signal we are dealing with is the "luminance" signal.)

It should now be clear that the bandwidth of the luminance signal determines the definition or the resolving power of the system. With electronic images definition is expressed in terms of the number of black and white lines that can be rendered over a given area of the frame, i.e. how many times can the signal change from maximum to minimum level (or vice versa) within a certain time span. A standard electronic image (at least the NTSC standard in the U.S.) is composed of 525 horizontal lines that are scanned 30 times a second. If for simplicity's sake we ignore the time required for the scanning beam to return across the frame to the start position for the next line or the next frame we can figure that the time spent scanning each line is 1/15,750th of a second. Imagine a resolution test chart consisting of 400 black vertical lines on a white field, and we can see that in order to resolve this image the voltage would have to change from peak (white) to minimum (black) and back again 400 times during each scan line or at a frequency of 6,300,000 cycles per second. In reality the time spent scanning each line is substantially less, so the frequency response necessary to resolve such a test chart would be even higher. If there were no image at all, but simply a white field; the frequency would be 15,575 cycles per second, since the signal goes to black for each return across the frame. We can see that a fully defined electronic image requires a signal capable of a range of frequencies from a few thousand to several million. This range is the bandwidth.

Cycles per second is abbreviated as Hertz (named after the 19th century scientist who first investigated electrical waves) which in turn is abbreviated with the symbol Hz. When the frequencies are in excess of a million, they can be referred to as MegaHertz (MHz). The standard bandwidth for the luminance signal in the NTSC television signal is 4.2MHz or 4,200,000 cycles per second.

Bandwidth refers to a range of frequencies. The highest frequency involved in a television signal may be substantially higher than 4.2MHz depending on what the lowest frequency in the signal is. For broadcasting television signals through the air the total range of frequencies available was divided up by the FCC into "channels" each of which could accommodate a signal with a bandwidth of 6 MHz, of which 4.2 MH were allocated for the video signal. The agreed upon standard for the bandwidth of a television signal was to some extent determined by the number of channels desired. There was a trade off between number of possible program choices and the limitations of the quality of the image which could be broadcast.

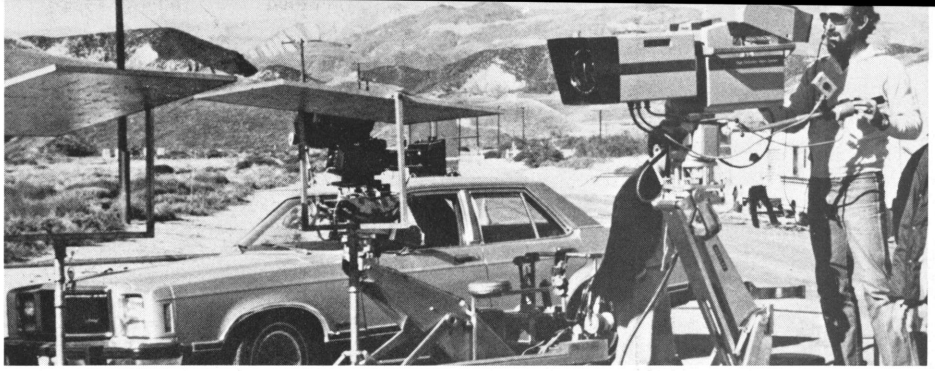
Even though it is not possible to broadcast a television signal with a bandwidth in excess of 4.2 MHz, it is advantageous to use equipment capable of processing a signal with a wider bandwidth for generating and manipulating the signal before it is broadcast. Thus there are cameras capable of resolving 800 lines (i.e. with a bandwidth of 10 MHz).

ments to evaluate all of the psychophysical factors in television viewing and concluded that a 5:3 aspect ratio was ideal for home viewing, although a wider format such as 2:1 might be preferable for large screen theatrical presentation. It should be noted that with a given number of scan lines and a given frame rate the wider the screen format the more stringent are the requirements for the electronics of the system (i.e. a 2:1 format would require a greater bandwidth than a 5:3 format).

Such work suggests that the movie theater as we know it will be replaced by an electronic one with distribution being accomplished via satellite or cable transmission. The question is how soon this can be technically and economically feasible.

Obstacles to HD-TV

There are several major obstacles to the adoption of high definition television. Perhaps the greatest obstacle is the question of compatibility with existing television formats. When color television was developed it was necessary that the color signal be designed to be completely compatible with the existing black and white receivers so that a show broadcast in color could be viewed in black and white. As a result some compromises were made in the quality of the color image, but color television was rapidly accepted and soon became the norm. Ideally it would be desirable to develop a high definition television system which could be similarly compatible with the existing 525 line or 625 line system. Unfortunately no one has yet conceived a means whereby this could be possible. The best that can be done is to design a high definition television system which is readily converted to a 525 line signal or a 625 line signal. Such a conversion via a standards converter is feasible in a way similar to the conversion of a 625 line PAL or SECAM signal into a 525 line NTSC signal. The problem is that it is not feasible to include this conversion hardware in a home receiver. Conversion to another standard will have to be accomplished prior to transmission. This is perhaps comparable to the steps required to make a 35mm motion picture available to people with 16mm projection equipment. It is not an insurmountable obstacle to the introduction of high definition television. It does not even mean that high definition television can not be transmitted into homes. It will simply require a different kind of receiver in the way a different receiver is required for FM radio broadcasts as compared to AM broadcasts.



Portions of an episode of "The Fall Guy" produced by Glen A. Larson Productions were shot simultaneously on HD-TV by setting up the camera next to the film camera and using the same lighting.

Ease of conversion is a factor in the choice of the number of scan lines for a high definition system. The NHK system has 1125 lines partially because the number is a multiple of 25 as are 525 and 625. Conversion is not simply a matter of the number of scan lines, however. The NHK HD-TV system involves a different method of encoding the color in the video signal. Essentially the color is transmitted as separate components of the signal rather than being combined with the luminance signal in the way it is with an NTSC, PAL or SECAM signal. This requires an even greater total bandwidth (The NHK system has a 30 MHz bandwidth.), but the result is vastly improved color rendition.

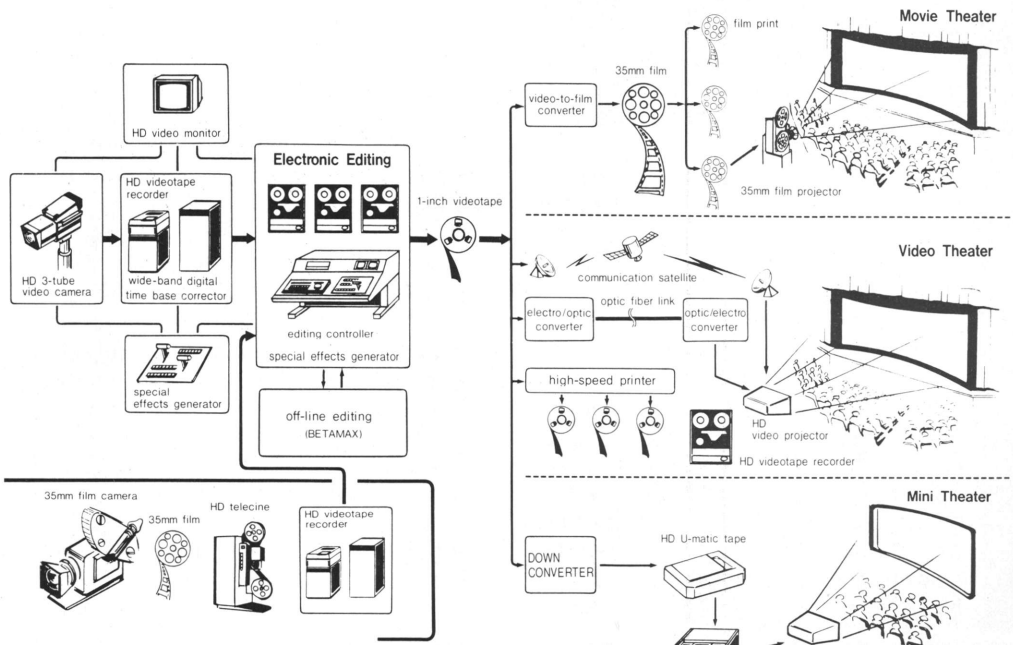
Broadcasting HD-TV

HD-TV is envisioned as a system for both home viewing and theatrical exhibition. Ironically the most immediately feasible applications of high definition television may be for theatrical production or exhibition. Most of us think of television as a home entertainment medium, and it seems strange that high definition television would be used in theaters before homes. Once you understand the problems involved in developing a high definition television system, however, the reasons for this become clear.

In order to transmit a high definition television signal it is necessary to use a much wider bandwidth than is required for the current standards. The bandwidth available for conventional broadcasting is limited by an agreement designed to establish the number of channels over which programs can be broadcast. Given a certain portion of the spectrum of electromagnetic frequencies suitable for transmitting television signals, the wider the bandwidth of each channel the fewer channels it is possible to have. As a result all broadcast equipment is designed to produce a video signal with a bandwidth of 4.2 MHz.

When color television was developed, it would have been easier to de-

The application of HD-TV to theatrical exhibition is outlined in this diagram by Sony. HD-TV could also be broadcast to home receivers by means of satellite or optical fiber cable.



sign a signal using a much wider bandwidth, but this was not considered a viable option because of the commitment to 13 VHF channels. It was possible to design a color signal to be completely compatible with the standard black and white signal and which did not require a wider bandwidth for transmission. This was accomplished by putting the color information on a subcarrier which is "interleaved" with the black and white "luminance" signal. Definition is a direct function of the bandwidth, however, and there is no way presently to transmit a signal with greater definition except by using a wider bandwidth. A high definition television system with 1100 lines requires a bandwidth of 20 MHz or more depending on how the color information is encoded, what the aspect ratio of the image is and a few other variables.

One area of research at NHK is bandwidth compression, but no one is suggesting that HD-TV signals could be broadcast over a conventional VHF channel. It would take at least three channels to broadcast a single HD-TV signal. While it is conceivable that UHF frequencies could be used for broadcasting high definition television, this would mean a complete restructuring of the channels available to UHF broadcasters. The most feasible means for transmitting HD-TV into homes is via direct satellite reception or cable. NHK has successfully broadcast HD-TV signals via satellite demonstrating there is no technical reason why HD-TV signals could not be transmitted to homes. NHK has also broadcast HD-TV signals by microwave directly from its laboratories to its broadcast center 8 km away, and Panasonic has developed equipment enabling a 30 MHz HD-TV signal to be transmitted via optical fiber cable. Even though it can not be broadcast over conventional VHF or UHF channels, HD-TV could be a separate option for the home viewer just as pay TV or cable service is now.

Display Devices

The problem then becomes that of manufacturing an affordable receiver or display unit for home HD-TV. NHK, Panasonic and Sony have developed prototype monitors and projectors for HD-TV. The original monitor developed by NHK was a 30" monitor with a zoom capability. Panasonic has also manufactured a 24" and a 28" monitor as well as 55" and 64" projectors. Sony has a 20" monitor and a 100" projector. The question is simply how soon such units could be economical enough for the consumer market, and how soon someone could begin broadcasting HD-TV signals to home receivers.

Ironically enough the SMPTE study group concluded that the demand for home HD-TV would probably only develop after HD-TV had been used successfully for theatrical exhibition. It is also possible that HD-TV systems will be developed first for limited closed circuit non-entertainment purposes before they can be marketed for home use. A frame of HD-TV is capable of reproducing clearly an 8" x 11" page filled with type a little larger than this, and some of the NHK/CBS demonstration as well as the literature from Panasonic suggested the use of HD-TV for corporate communications and conferences. CBS has applied to the FCC for permission to broadcast HD-TV via satellite over three channels in the frequency range above UHF. One channel would be for advertiser supported programming and the other two for subscription television.

The technology already exists to make HD-TV projectors for use in theaters. In fact there are two projectors already available which are capable of a horizontal resolution equivalent to a 1100 line image: the Aidophor projector and the GE light valve projector. Other existing projectors could also be modified to handle HD-TV signals. Another way in which HD-TV could be used for theatrical exhibition is through the use of film transfers from HD-TV videotapes. NHK is developing a laser tape-to-film transfer system for HD-TV which can produce images which are said to be even sharper than normal 35mm release prints. Because the system employs a laser beam to expose the film, it can make use of the finest grain color films. Moreover because the full video frame can be put onto each film frame and projected without the 2:1 interlace, the film transfer makes full use of the 1125 lines. The net result is an image having the definition of a 1625 line interlaced television image. If such a tape-to-film transfer system becomes commercially available soon, production in HD-TV for exhibition on film may be the first form of HD-TV production.

HD-TV Production Equipment

The means of producing HD-TV signals have also been developed by NHK along with Ikegami and Sony. NHK has made three HD-TV cameras using various types of pick-up tubes designed to have the increased resolution required for HD-TV. Their latest camera for the 1125 line system uses three 1" diode gun Saticon tubes. Both Ikegami and Sony had HD-TV cameras generating images for the NHK/CBS demonstration. These cameras were used for shooting the HD-TV videotapes used in the demonstration as well. For the scenes from the episode of THE FALL GUY, the HD-TV camera was operated right beside the film camera in each set-up. NHK has also developed a 70mm telecine using a laser flying spot scanner for making HD-TV signals from film.

The most difficult aspect of the development of HD—TV has probably been the production of the means for recording the HD-TV signal. NHK experimented with a flexible magnetic disk recording device and recorded signals in the 15 to 18 MHz range. They then modified a 1" type C videotape recorder so that it is capable of recording a 1125 line video image. This was accomplished by doubling the rotation speed of the head and increasing the tape speed to four times normal. Further modifications have been made in order to avoid noise problems by recording the luminance signal and the chrominance signal on separate channels. Also the increased rotating speed of the head requires a special time base correction to remove a head blanking interval in the middle of the frame.

A ten inch reel of tape on this machine can record 22½ minutes of program material. Sony has also developed an HD-TV videotape recorder using 1" tape. The Sony machine has a tape speed of 48 cm/sec as opposed to 97.6 cm/sec with the NHK machine. The Sony VTR will record up to 48 minutes of material on a reel of 1" tape. The Sony machine is also capable of editing functions and was the machine used for recording and editing the videotapes for the NHK/CBS demonstrations. Sony has also developed a digital time base corrector for the HD-TV system.

The NHK/CBS demonstrations have made it clear that high definition television is a reality. Whether the 1125 line system will be adopted as a worldwide standard remains to be seen. Developments in the technology appear to be happening very rapidly, and many experts may be hesitant to establish a standard for HD-TV without further exploration of the possibilities. ■

PANACAM® REFLEX

A video camera from Panavision with a reflex viewfinder and the full complement of Panavision lenses which enables a film crew to shoot videotape in exactly the same way they would shoot film.

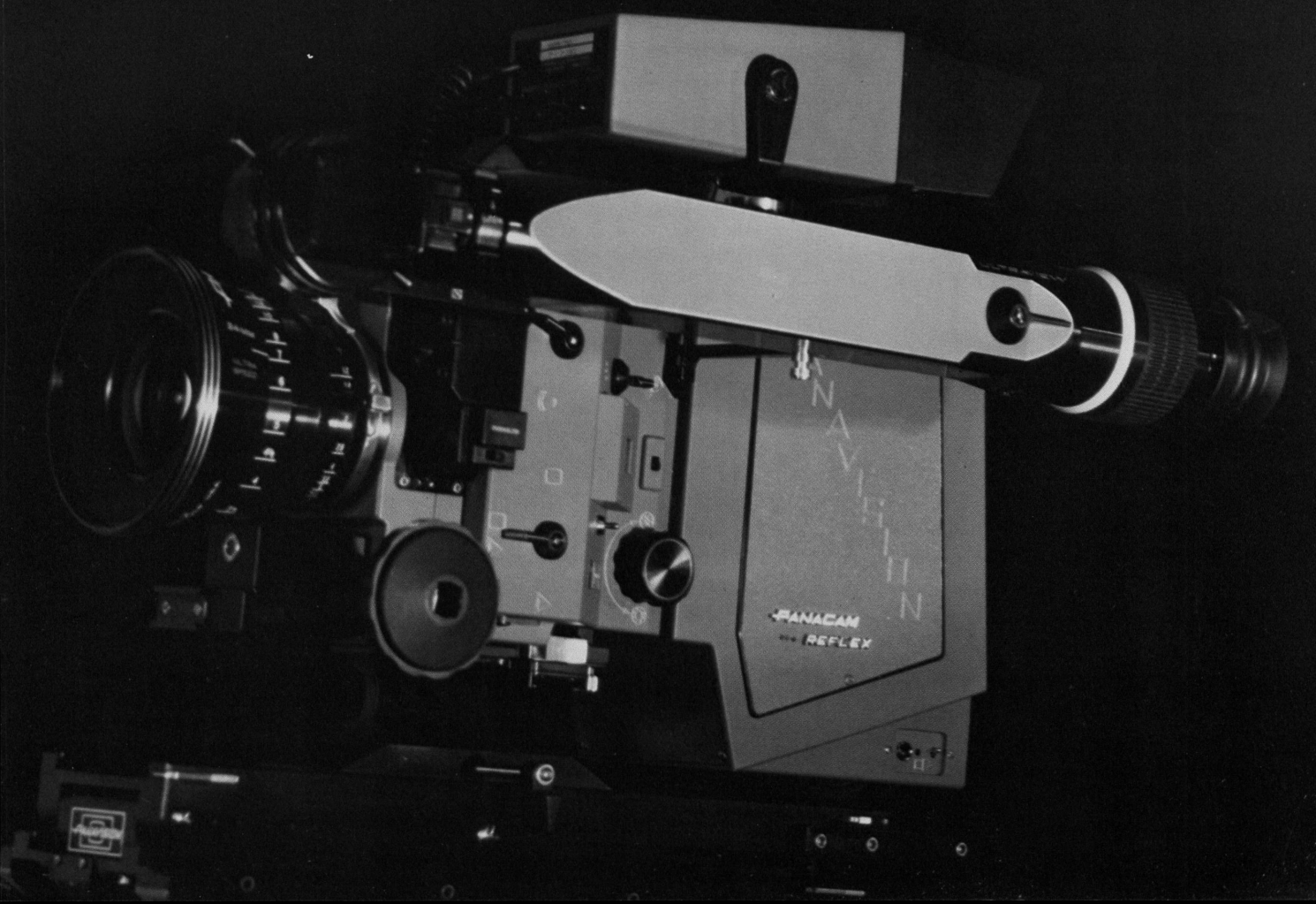
By ROBERT E. GOTTSCHALK
President, Panavision Incorporated

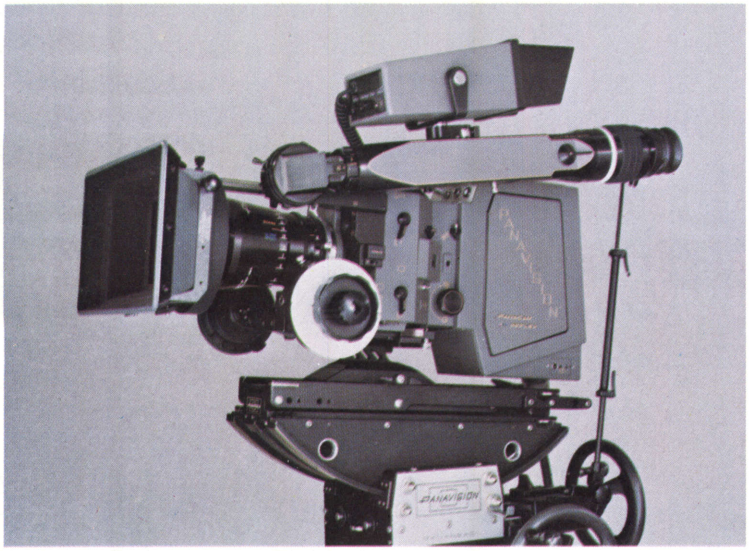
About six years ago, Panavision started on a program to study the use of Panavision lenses with video cameras.

Because of the problem of the longer focal lengths not being suitable for the ⅔" video tubes, I decided that we would attempt the design of an optical system to convert the focal length of Panavision lenses so they would be practical for the ⅔" video camera.

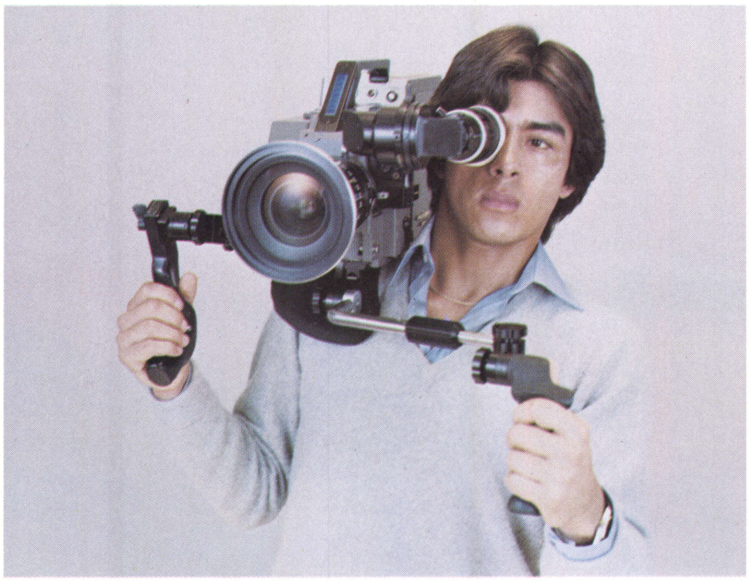
After many months of computer design, we were successful in achieving an optical system that allowed us to design an entirely new video camera specifically for the cinematographer. Consequently, Panavision, after further thorough investigation decided to join forces with Commercial Electronics Incorporated of Mountain View, California, the manufacturer of the highly respected CEI Video Camera. Since CEI was a company which shared Panavision's philosophy of manufacturing the highest quality equipment in its field, the engineering concepts which both companies shared proved to be highly compatible. The resultant camera which we call the Panacam Reflex is the first and only actual motion picture camera that photographs on tape instead of film.

As the name Panacam Reflex denotes, it is a camera with which a cinematographer can instantly relate when shooting for television and will feel comfortable with since it has all the features of the Panaflex. The Ultraview Reflex Viewing System, Panaglow, Panaclear, Panalite, Pana-

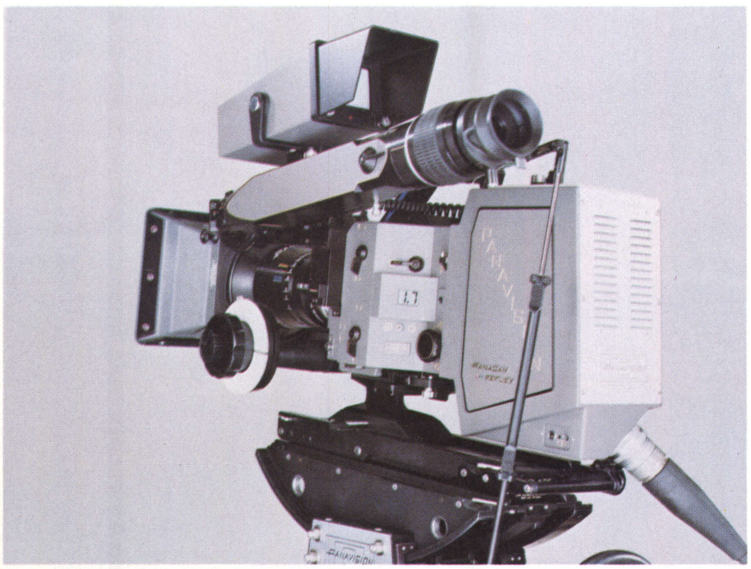




The Panacam offers a choice of a reflex viewfinder or an electronic viewfinder. The electronic viewfinder can be mounted on the camera body, or it can be mounted on the reflex finder so that it benefits from the Eyepiece Leveling System.



The Panacam converts easily to a hand-held configuration and weighs less than a Panaflex. The hand holding accessories designed for the Panacam are so comfortable that they will be furnished with the Golden Panaflex as well.

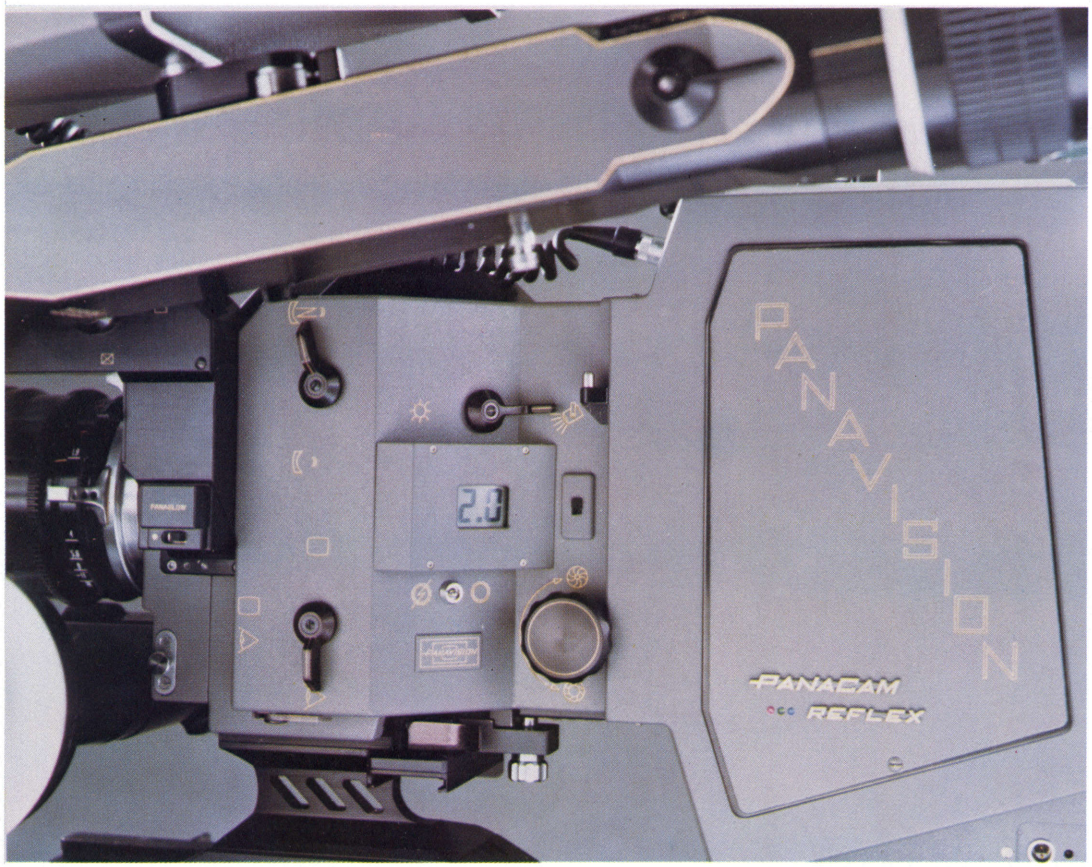


head, Eyepiece Leveling System and all the accessories with which the cinematographer is familiar are included in the Panacam Reflex. Of most importance to the cinematographer, the Panacam Reflex is the only video camera which has a Reflex Viewfinder allowing the cinematographer to view through the lens.

The CEI 310 camera was well suited to its marriage with the Panaflex because of its modular design. This design of the Panacam Reflex permits it to be upgraded easily as new circuitry is developed. Many of the electronic circuits normally mounted in the body of a video camera have been separated from the camera head in the CEI 310 and mounted in an electronics unit—thereby greatly reducing the weight and size of the camera head. The net result is that the Panacam Reflex is actually lighter than the Panaflex and is ideally suited for the industry's standard support mechanisms such as dollies and cranes using geared or fluid heads. Also, a wide assortment of standard Panaflex accessories, including matte boxes, follow focus controls and other items add to the versatility.

The camera converts in minutes to a hand-held configuration with unique multi-adjustable form-fitting grips. The Panacam Reflex's hand-holding accessories are so comfortable to the operator that they will be furnished with the Golden Panaflex.

The lenses and the reflex viewing system for the Panacam Reflex are identical to the Panaflex except for the fact that the iris in the lens is always kept wide open and there is no shutter. This means that the operator always has a bright, completely flickerless image in the optical viewfinder. There is a small lever on the side of the camera which enables the operator to select three different modes for the reflex viewfinder. In one position, all of the light from the lens goes to the finder. This gives the brightest possible image in the viewfinder and would be used only for lighting extremely dark scenes. When he is actually shooting, he can choose between two other positions. In one position a very small percentage of the light goes to the viewfinder and the rest goes to the video tubes. This is the most often used mode under general lighting conditions and allows the operator to use both the video monitor and optical viewfinder. The last position allows all of the light to reach the video tubes for shooting in exceptionally low light conditions. The electronic finder has a 3" screen displaying a black and white image, and it can be mounted in two different places: on top of the main body of the camera or on top of the reflex finder. Mounting it on top of the reflex



The five controls on the side of the camera include the selector for long or short focal length lenses and the selector for daylight or tungsten light on top. On bottom is the viewfinder selector for splitting the light between the viewfinder and the camera, the switch for automatic or manual exposure control and the manual f stop knob. The f stop is indicated by the digital display in the center.

finder enables it to benefit from the viewfinder leveling system which keeps the finder level as the camera is tilted. The position of the electronic finder can be adjusted so that an operator with either eye to the reflex finder can see the electronic finder with his other eye, or it can be swiveled around to face any direction so that an assistant can view the shot via the electronic finder while the operator uses the reflex finder.

The Panacam Reflex finder comes equipped with the same Panaglow and Panaclear features as the finder on the Panaflex. Panaglow is a means of illuminating the frame lines on the ground glass for low light shooting, and the Panaclear system heats the eyepiece cover glass to prevent moisture condensation in cold weather.

Lenses and Internal Optical System

When the reflex finder is used during shooting, the light coming through the lens is split by means of a pellicle mirror. Then the light to be used to form the image on the pick-up tube is routed through an internal optical system designed especially for the Panacam Reflex. The purpose of this system is essentially to reduce the size of the image to conform to the format of the ⅔" pick-up tubes. Normally, if a 35mm motion picture camera lens is mounted on a video camera with ⅔" tubes, a portion of the image would be wasted. For example, when it is mounted on a conventional video camera, a 50mm lens for a 35mm motion picture camera would yield a field of view equivalent to a 120mm lens on a 35mm motion picture camera.

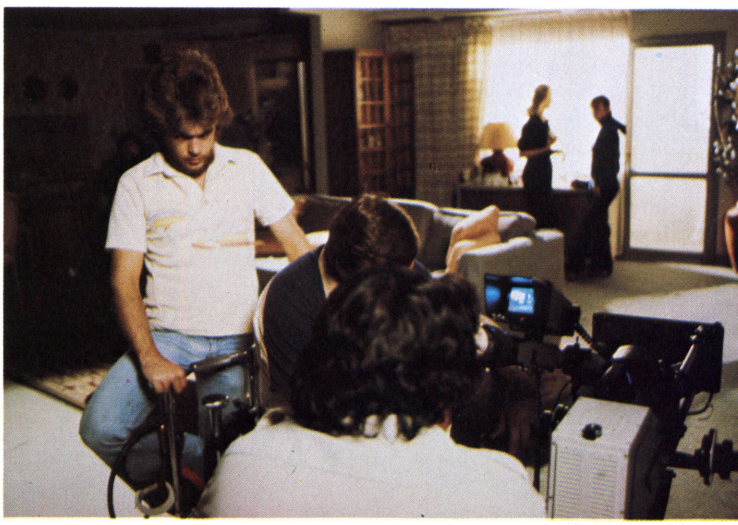
If the cinematographer would choose a 50mm lens for a certain shot using a Panaflex, then he would use this same lens on the Panacam Reflex and would achieve the same field of view because the Panacam Reflex's internal optical system converts the 50mm lens to the proper focal length for the ⅔" video tubes. Because the internal optics reduce the size of the image and concentrate the light onto a smaller area, it increases the effective speed of the lens. The net result is that some Panavision lenses are faster on a Panacam Reflex than on a Panaflex even though it is producing the same field of view. A lens that is normally a T4 becomes a T1.7 lens when mounted on the Panacam Reflex.

The optical system inside the Panacam Reflex converts the focal length of the nor-

SHOOTING WITH THE PANACAM

The first actual use of the Panacam was an all day production test at Metromedia involving three scenes with girls rehearsing a dance number. Cinematographer Hector Figueroa discusses the first set-up with director Joseph Sargent. The sequence began with a shot of the girls walking along the sidewalk. When they entered a rehearsal stage, the camera followed them, using the electronic color correction to switch from daylight to tungsten balance in the middle of the shot.

(ABOVE LEFT) Figueroa uses the 3″ viewfinder for a low angle hand held shot of the dance number. The Panacam is lighter than a Panaflex and can be held by means of a handle on top or mounted on the operator's shoulder. (ABOVE RIGHT) The video man adjusts the controls on the electronics unit for the Panacam. The microprocessor in this unit automatically monitors and corrects the registration of the image in addition to performing a host of other functions. (BELOW LEFT) Sargent checks a composition in the viewfinder. The Panacam is the only video camera made which permits viewing directly through the lens in addition to viewing with an electronic viewfinder. (BELOW RIGHT) The final scene took place in an apartment and was deliberately staged to include a back lit shot that would normally be avoided with a video production as well as a practical lamp which was turned on during the scene.



mal Panavision lenses without introducing distortion or affecting definition. Its unique and highly complex design utilizes some of the newest of rare earth glasses to compensate for the dividing prism and to achieve this aberration free conversion. The resolving power of the total optical system exceeds the reproduction ability of the standard video display.

The following table shows the lens speed and the video lens equivalent for each of the Panavision lenses.

PANAVISION LENSES

PANAFLEX MM	Converts To	PANACAM MM	
14	→	5.6	T1.7
17	→	6.8	
20	→	8.0	
24	→	9.6	
29	→	11.6	
35	→	14.0	
40	→	16.0	
50	→	20.0	
75	→	30.0	
100	→	40.0	
125	→	50.0	
127	→	50.8	
150	→	60.0	
200	→	80.0	
300	→	120.0	
400	→	160.0	
500	→	200.0	T1.7
1000	→	400.0	T2.5
ZOOMS			
20/100	→	8/40	T1.7
25/250	→	10/100	T1.7
23/460	→	9.2/184	T4

Controls On the Camera

The internal optical field adjustment system in the Panacam Reflex can be adjusted for use with lenses under 100mm and for use with longer focal length lenses and all zoom lenses. There is a selector lever on the side of the camera for choosing the proper configuration.

There is also a selector lever which introduces an 85 filter in the internal optics. When shooting in daylight, the cameraman has the option of correcting with the built-in filter or by introducing filters in the matte box or behind the lens.

The iris controlling the exposure is mounted in the internal optical system. The iris can be set manually by means of a knob on the left side of the camera, or it can be automatically controlled by the computer in the electronics unit. There is a switch on the camera to enable the operator to select manual or automatic exposure control. The T-stop at which the iris is set is displayed on a large illuminated liquid crystal digital display on the side of the camera visible to both the operator and his assistant.

Electronics From the CEI 310

The Panacam Reflex is generally equipped with either three ⅔" Saticon tubes or with low capacitance diode gun Plumbicon tubes. The electronics for the camera are based on the electronics in the CEI 310 but they have been remounted onto a more rugged chassis and numerous modifications have been made to incorporate all of the other electrical features of the Panacam Reflex.

Automatic Registration

One of the most important electronic features of the Panacam Reflex is the computerized registration and exposure control. Although the Panacam Reflex is an extremely stable camera, all video cameras are subject to minor registration drifts and only the Panacam Reflex provides full-time monitoring and continuous correction of minor registration error. While the camera is in use, the microprocessor in the electronics unit is continuously analyzing the image and adjusting the registration of the three tubes. It does this by means of a scanning pattern which periodically samples every point in an oval area covering perhaps 80% of the total image. The cycle takes 16 seconds and keeps repeating constantly whenever the camera is on. The process is deliberately slow so that corrective action is not apparent in the recorded picture. The computer reads every point above a certain brightness level, compares its precise location in the red, green and blue images and then continually adjusts the registration. The scanning pattern is designed so that the computer will not misinterpret camera movement or movement within the frame as a registration problem. Because registration can be influenced by changes in temperature, it is possible for it to drift, even during a shot, unless it is corrected in this manner. What was once a tedious procedure and a necessity during production is now automated, eliminating delays during production.

Exposure Control

The sensitivity of the camera is roughly equivalent to shooting with an ASA 100 film. There is a step gain control on the electronics unit with positions marked "×2" and "×4" which enables the cameraman to do the equivalent of pushing his film one to two steps with the flip of a switch. There is also an automatic exposure control system with some very elaborate methods of setting the exposure.

The brightness of the image is measured in a series of sample points arranged in a diagonal pattern over the entire picture area. The computer averages the brightness range covered by these sampling points and automatically sets the iris to produce the optimum exposure for the pick-up tubes. If for any reason the cameraman wants the automatic exposure system to ignore a portion of the frame, he can easily move the sampling pattern up and down. The monitor in the electronic finder can be made to display the exposure sampling points superimposed over the image so the cameraman can position it to avoid specific areas of the image. The most common use of this feature, which is called an "iris window shade," would probably be to ignore sky areas or lighting fixtures in the upper portion of the frame.

In addition, the Panacam Reflex includes the CEI tone capture circuit for exposure control. This feature enables the exposure to be set automatically for any color within the scene. In order to set the tone capture the cameraman frames a shot so that the designated sampling point is superimposed over the specific color for which he wants to expose. He then presses a button, and the computer remembers to expose for that color whenever it is in the frame. The most obvious application of this feature is in exposing for flesh tone. The cameraman can set the system to expose for a person's face and it will hold the proper exposure for his flesh tone even when he walks in front of a window and is severely backlit. The window area may burn out, but the exposure on the person's face will remain consistent. Tone capture iris control is unique to the Panacam Reflex and CEI cameras. It can be adjusted to set the exposure for the selected tone at anywhere between 60% and 90% of full exposure.

The same controls can be used to make the camera function as a spot meter. If the selector switch for the automatic iris is in the normal position rather than the tone capture position and the tone capture button is pushed, the result is that the iris will lock into its present position and the central sample spots or cursor for the exposure sampling pattern will be designated to function as a spot meter. It will produce a readout on the monitor telling the cameraman the percentage of full exposure represented by whatever portion of the scene is beneath the cursor, i.e. it tells the cameraman the video level for that spot with the iris at that particular T-stop. This is particularly useful in balancing lighting across a scene or calculating contrast range.

Other Electronic Features

There are many other electronics features of the Panacam Reflex which may interest a film cameraman who is new to video. There is a gamma control switch with a variable position permitting the gamma to be set at any value between 1.0 and 1.35 (in addition to the two standard

positions of 1.0 and 0.45). There is an automatic white balance system which enables the cameraman to correct the color because of the light by sampling a small white or gray area within the scene rather than filling the frame with a white card. All he has to do is frame up so that one cursor representing less than 1% of the frame is positioned on a white or neutral gray area and push a button on the camera unit telling the computer that the sampled area should be white or gray. If for any reason the area sampled is really nowhere near white or gray, the computer will read out on the monitor telling him to manually adjust the red or blue gain—indicating that the sampled area is not really appropriate or the color temperature of the light is too far off to permit automatic correction. There is also an automatic black level and an automatic black balance.

There is a dynamic beam optimization circuit which will prevent highlight flare or sticking with up to 4 stops overexposure. There is a black stretch control to bring out details in shadow areas without affecting the color, and a tint control to permit flesh tone adjustment without affecting the black or white balance.

The electronics unit generates time code (either drop frame or non-drop frame) and it enables the cameraman to make use of the additional characters or "user bits" which accompany the time code information but are not normally displayed. User bits with the time code can be used for recording reel numbers or dates or any other pertinent information to be recorded along with the picture.

The electronics unit enables the camera to operate on 24 volt D.C. current or 95 to 250 volt A.C. current at anywhere from 48 to 63 cycles per second. It automatically adjusts the voltage to suit the camera's needs. It will also test the battery and display an indication of whether the charge is high or low. An important unique feature is that the Panacam Reflex converts to other TV standards such as the European PAL System in seconds.

The electronics unit is connected to the camera cable and can be up to 600 feet away. It weighs 19½ pounds, is 14½" × 13" × 5" and can be laid out flat or stood on its side during operation. When combined with a monitor, it provides the video man with everything he needs to adjust and control the operation of the camera in the field. Elaborate set-up equipment is generally not needed to routinely monitor the camera during shooting.

There are numerous other features of the Panacam Reflex which are beyond the scope of this report. Many are things which are of interest primarily to a video engineer and which do not concern the cameraman directly anymore than some of the chemical processes at the film laboratory. What the cinematographer needs to know about the Panacam Reflex is that it is a camera he can use just like he uses the Panaflex. Anything he might ask the lab to do in processing his exposed film, he can ask the video man to do to his video signal as it is recorded. He can use the same camera crew he would use for shooting film and light to the same level as if he is shooting color negative.

While the Panacam Reflex is a very new camera having been available for only three months it has been tested and used by a prestigious group of production companies which includes ABC Television, Metromedia Channel 7, Compact Video in addition to a number of TV commercial production companies. This group has been unanimous in their praise of the camera especially commenting on the "film look" of the image which they say no other video camera has given them. It is very gratifying that the demand for the camera has exceeded Panavision's present supply of cameras—a situation very reminiscent of the time when the Panaflex was introduced ten years ago.

The Panacam Reflex is truly *the* film cinematographer's video camera. But video is video and film is film and both have their distinctive and definite places. ■

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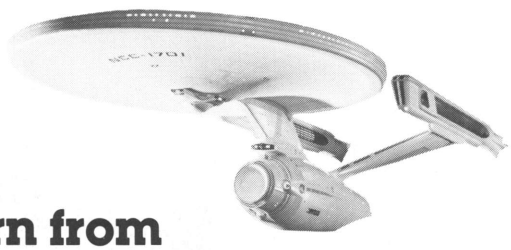
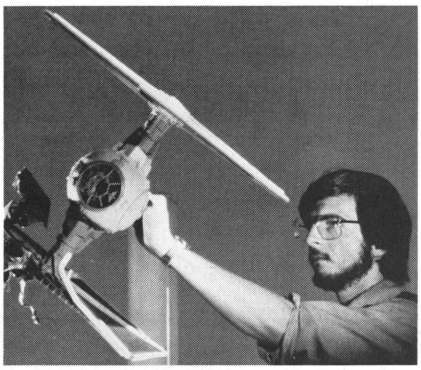
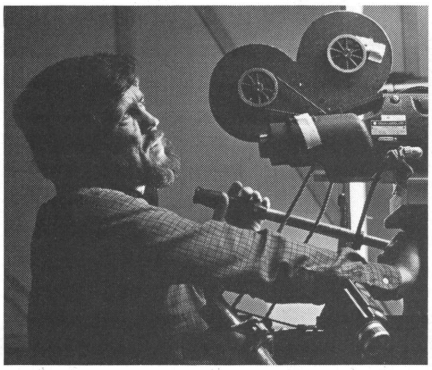
Answers: A—Natural Fog; B—Scenic Fog Effects Filter

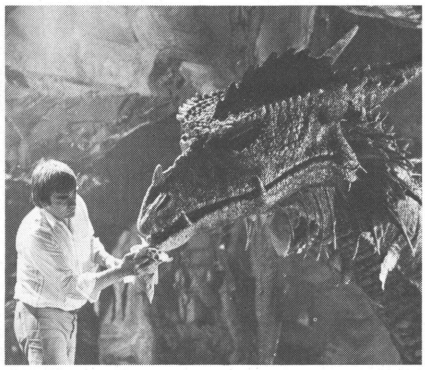
"Cinefex has become the journal for the practitioners of the complex art of 'trick photography' or special visual effects — we all read it and learn from it. Cinefex is always beautifully printed with color production shots and rare behind-the-scenes material. Don Shay, the publisher, has the ability to present detailed and poignant information which is at once valuable to fellow effects artists, interested fans of the art, and even producers who need visual effects in their films."



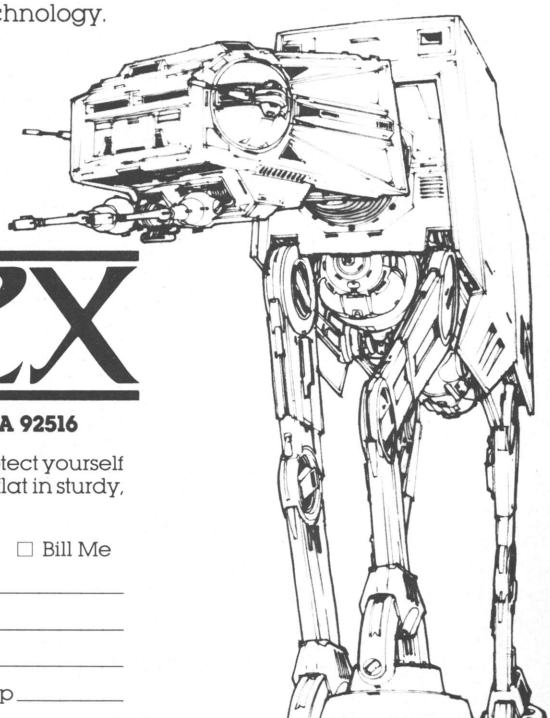
Richard Edlund — visual effects supervisor
'The Empire Strikes Back' and 'Raiders of the Lost Ark'







From the flamboyance of a lumbering dinosaur or soaring spaceship to the subtlety of a well-integrated matte painting, Cinefex unveils the world of special effects in consummate detail. Focusing on cinematic illusions both grand and small, Cinefex goes right to the source, offering readers incisive articles and penetrating interviews on optical and physical effects, creative makeup, and exotic production design. Subscribe now, and in issues to come you will find unsurpassed coverage on effects films old and new — revealed in the words of the cinemagicians who infused them with visual wonder. And if you've been wondering what motion control, traveling mattes, computer animation and front projection are really all about, you'll find that, too. Because Cinefex covers the field — the films, the people and the technology.



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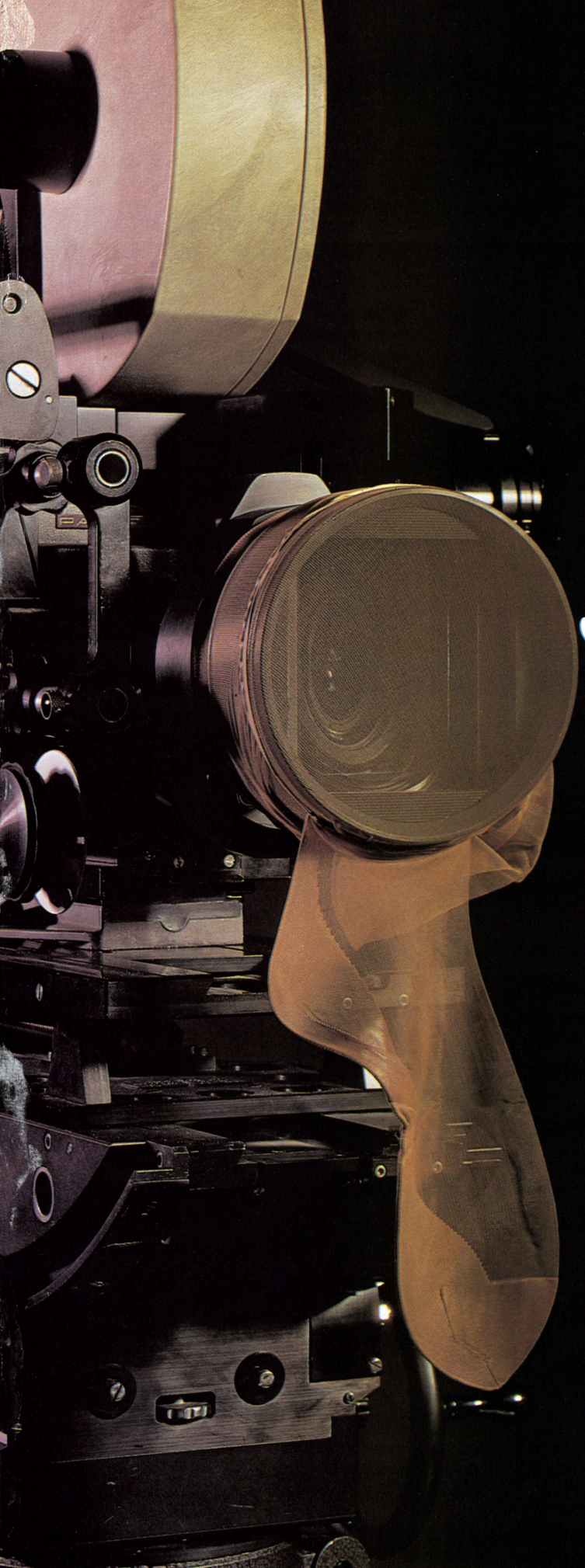

"I can remember when we taped silk stockings over a lens.

And that's not so long ago" says lighting cameraman David Holmes, B.S.C.

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The High Speed 16SR at the Lake Placid Olympics:

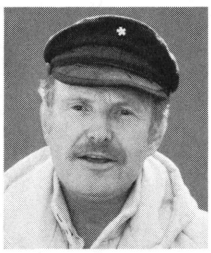
The 16HSR has same features, uses same accessories, is powered by same on-board battery as standard 16SR.

"When my beard gets completely white from breath frost, I know it's ten or twenty degrees below zero," says Jim Taylor who lives in Vermont.

"The day we filmed the Downhill, my beard was white. We were at the top of Whiteface Mountain and it was *cold*. People were having trouble with their cameras."

150 fps instantly.

"I was using one of the production's HSRs, switching it on at 100 and 150 frames per second. I didn't have to anticipate the athlete's movements. Even in *that* weather, the HSR got up to speed right away."



Ron Lautore and the old grandmothers:

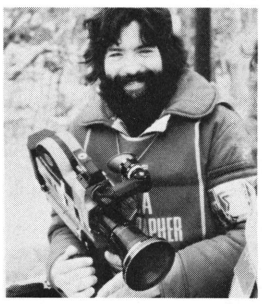
Ron Lautore was the producer of official filming for the Lake Placid Olympic Committee. "Our aim wasn't just to show the winners," he says. "We wanted to show the discipline. A ski jumper can practice for seven years and it comes down to one jump. If he gets hurt in practice — for him *that's the jump*."

"I had six camera crews assigned to me by the committee. Only one cameraman I had ever seen before. They had all brought their own cameras. I also had the first three High Speed SRs to arrive in the U.S.A."

"Cameramen are all old grandmothers about equipment," says Mr. Lautore. "They get used to their own gear . . . We had about ten minutes to introduce each one to the HSR. After the usual preliminary grumbles, they went out to shoot — and every one of them fell in love with the camera. Now I had six cameramen, each begging me to let him use one of the three HSRs."

Crews had to ski to location.

"I didn't expect to depend so heavily on the HSRs. We'd been told they were high-speed cameras — but they turned out to be more than that. For some shots, the crews had to ski to the locations. When they got there, they could shoot both high speed *and* sync sound with an HSR. After three days, we re-arranged our schedules to build the production around those three cameras."



Jim Taylor

"It was important to do everything in a low-key way," says Mr. Taylor. "I held still at crucial moments and the HSR was quiet — so the officials let me get closer and closer to the Downhill starting hut."

It *wasn't* an exotic high-speed.

"The Lake Placid Olympic Committee paid me to bring my own equipment," says Rick Rose. "But after using an HSR, I hated to go back to my own camera; and I think my camera is a good one."

"Shooting sports for television, you seldom need more than 150 frames. The HSR gave me confidence because it *wasn't* an exotic high-speed – it was a regular Arriflex. Easy loading, fast changes, Zeiss lenses; and quiet."

Rick Rose

Four feet away.

"Finally, I ended up about four feet from their skis. I was down in the snow, looking up, using the wide end of the 10-150, shooting at 24, 100 and 150 frames."

"The Bobsled Run start was another place where you had to be unobtrusive. To prepare for as fast a start as possible, the team concentrated and breathed in unison. Everything was quiet. Officials saying: *Shhh*."

Shot possible only with 16HSR.

"The shot I got there was from just behind – ice being kicked into the lens as they pushed away. Before that, at 150 frames, you could see the intensity of concentration, the effort being put into those few seconds. We couldn't have gotten that shot with a noisy high-speed camera."

Sync effects.

"While I was getting high-speed footage, soundwoman Barbara Potter would be recording wild effects. Then we'd walk over and do an impromptu interview, or we'd shoot crowd reactions in sync. All with the same equipment."

"For me, that's the beauty of the HSR – the flexibility. That, and it's an Arriflex."

If you have questions about their experiences with the 16HSR, you can call Rick Rose at (602) 795-9295, and Jim Taylor at (802) 658-3954.

Sync sound with the 16HSR

Jim Taylor and Barbara Potter shooting sync sound with 16HSR at Lake Placid. "We shot several interviews outdoors on the quiet mountain sides," says Mr. Taylor. "Barbara used a shotgun up close and I'd be on a tripod about 10 ft. back. Played back on the Nagra, you could not hear the camera."

The 16HSR

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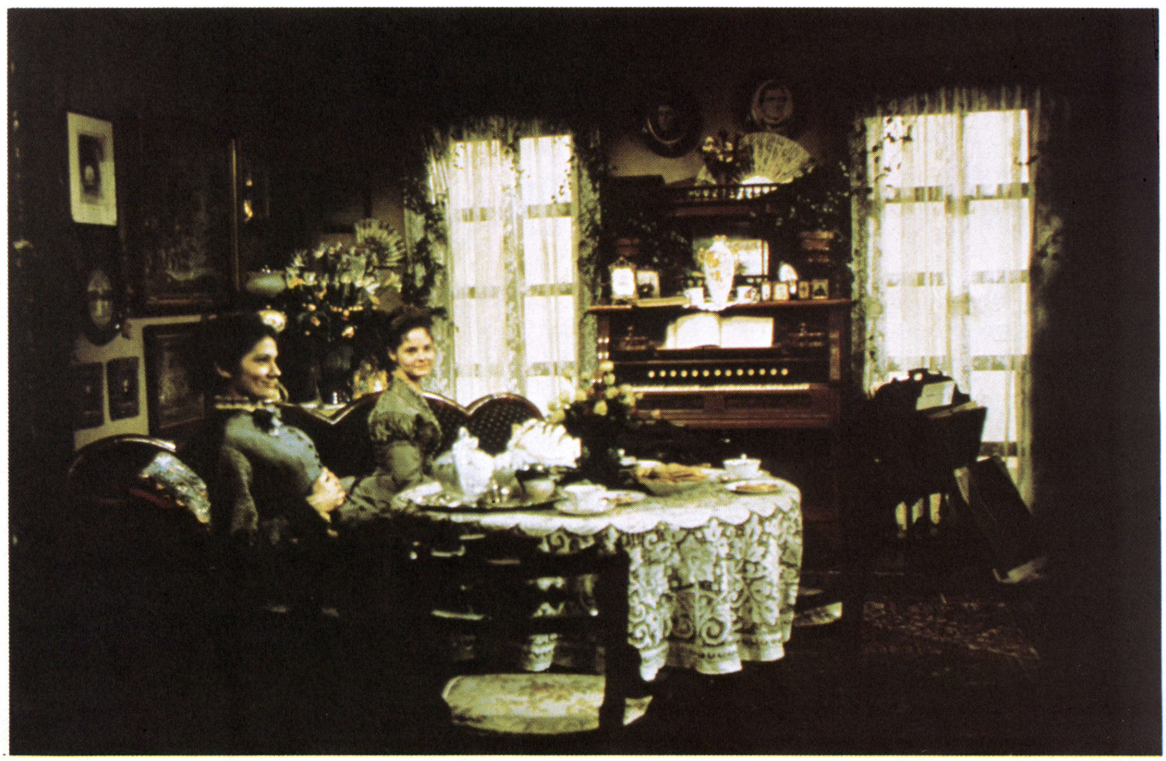
The television production of "Look Back In Anger" starring Malcolm MacDowell was lit by David Clark, another staff lighting director at Imero Fiorentino Associates.

George Riesenberger was among the IFA personnel involved in the production of "The Best of Families," a dramatic series taped for public television at the old Twentieth Century Fox Studios in New York.



LIGHTING FOR VIDEO

For this introduction to lighting for tape as opposed to film American Cinematographer *consulted with three lighting directors at Imero Fiorentino Associates, a firm specializing in lighting for television and the performing arts. George Riesenberger won an Emmy in 1979 for his lighting of "You Can't Take It With You." He has over 30 years experience in lighting for television with credits ranging from the Ali-Foreman fight in Zaire to a recent PBS production of a musical based on Studs Terkel's book* Working. *Greg Brunton won an Emmy in 1978 for his lighting of "Cher . . . Special" and recently lit the taping of Camelot with the original Broadway cast for cable television. William Klages, Vice Chairman of the Board at IFA has won three Emmys for lighting direction, one of which was for Ingmar Bergman's "The Lie." We also interviewed Leonard South ASC, who has worked in tape in addition to his numerous feature film credits, and Anton Wilson, who is well known to our readers for his Cinema Workshop column.*

There is a great deal of talk about a "film look" as opposed to a "tape look", and it is important to understand exactly what the difference is and what the reasons for it are. To what extent is the difference really a difference in working methods rather than a difference inherent in the recording medium itself? When most people talk about a "tape look", they are generally referring to the kind of lighting associated with multiple camera shows done on tape. To a large extent the "look" of the show is more a function of the fact that it is lit for multiple cameras than the fact that it is shot and recorded electronically. Lighting for multiple cameras which may be shooting reverse angles simultaneously as well as long shots and close ups imposes restrictions on the lighting style which have a radical effect on the "look" of the show regardless of whether it is on film or tape. The problems of lighting for multiple cameras are not really what we are concerned with here, although they may be the first thing to come to a cinematographer's mind when he contemplates shooting for tape rather than for film.

There is obviously no law that says electronic cinematography has to employ multiple cameras. It has traditionally relied on multiple cameras because of its origins in "live" broadcasting and its association with stage shows performed before an audience. There is a trend emerging, however, towards electronic cinematography using single camera techniques of the sort traditionally associated with film. As the working styles of film and tape productions converge, there is an increasing demand in tape productions for cinematographers experienced in single camera lighting and shooting techniques; and it behooves every cinematographer to understand whether or how lighting for an electronic camera differs from lighting for a film camera.

In a broad general sense it is now realistic to say that there is no difference in lighting for tape and lighting for film—given state-of-the-art electronic cameras and recorders. Leonard South, ASC insists that he would make no changes at all in lighting the set for multiple camera show if he were told that a decision had been made to switch from film to tape. Or as Greg Brunton, a lighting director with Imero Fiorentino Associates, puts it, "There is no real major difference in lighting. A camera is a camera, and light is light. It is only the style in which you are shooting that requires you to light the way you do."

This has not always been true, and in certain situations there are still differences between film and tape which can affect the lighting. For the most part, however, the differences in the lighting of a videotape production and a film production are a result of working methods and personnel. If a cinematographer wants to achieve "film style" lighting in a videotape production, it is helpful to know how and why things are normally done in a tape production.

Contrast Ratio

The most important inherent difference between film and video is the brightness range or contrast ratio which each can successfully reproduce. Film is generally considered to have a contrast ratio of at least 100:1 (a range of between 6 and 7 stops) while video is limited to a contrast ratio of 30:1 (or about five stops). This difference is compounded by the difference in the viewing conditions for each medium. A film image projected onto a screen in a darkened room can obviously reproduce a much greater brightness range than an electronic image viewed on a television tube in a fully lit room. The television screen itself is never fully black, and the viewer's eye will never adjust to differences in the brightness of a television screen in the way it would to differences in the brightness of a large theater screen. A normal home receiver can be considered to have a contrast ratio of about 20:1. If a film is being shot for television broadcast, then of course it is subjected to the same viewing conditions, and its effective contrast ratio is reduced as well. But inherent in the electronic system is a limitation of the contrast ratio relative to what film can handle.

What happens if the brightness range of the subject exceeds the 30:1 ratio which an electronic camera can reproduce? If the light level falls too low in shadow areas, there is simply a loss of detail. With older cameras inadequately lit shadow areas could result in a kind of "noise" in the image known as "dark current", but more recent pick-up tubes have been designed to eliminate this problem. The real problems occur in highlight areas which are too hot. Because of the nature of the pick-up tube, hot highlights can produce various kinds of distortions. "Blooming" is one effect caused by hot highlights. It is similar to halation in a photographic image: the highlight spreads onto the image area around it. Another problem associated

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with hot highlights is "lag" (in which a highlight from one image carries over into the next) or "comet tailing" (in which a moving highlight leaves a trail behind it). This is caused by the fact that the image of the highlight is retained too long by the pick-up tube. Sophisticated electronic cameras have circuits designed to minimize such effects, but extremely hot highlights can still be a problem and should be avoided in electronic cinematography. Generally the problems with highlights are greatest in location work where the camera will pick up glare from sun being reflected on a shiny surface or where there is no way to avoid getting something like a very bright chandelier in the shot. It can also be a problem on a stage when sets have practical light fixtures in them. Often on location nothing can be done, but in the studio it is possible to put the practicals on a dimmer or to line the shades of the lamps in order to cut down the light to an acceptable level.

Exposure Control

Because highlights tend to be more problematical than show areas, the practice in electronic cinematography is to set the exposure for the highlights and let the shadows fall where they will. As with film the exposure is controlled by means of the f-stop. In low light situations it is possible to increase the video gain in a way comparable to force developing film. There is usually a switch which will permit an increase in the video gain level in six db increments. Each 6 db increment is the equivalent to pushing film one stop, and boosting the video gain in this manner results in an increase in the noise level of the video image which is the equivalent of increased grain in force developed film. Generally in a video production the f-stop is set by the video man rather than the cinematographer or lighting director. The video man sets the f-stop in order to set the "white level" or peak signal amplitude for the scene at a certain standard level. In most ENG or EFP cameras the iris for the lens is automatically controlled to limit the peak brightness, but in studio situations the f-stop is set by the video man using a wave form monitor to limit peak voltage of the signal to a standard level. In designing the lighting for a show a cinematographer or lighting director will establish the light level he wants to use, but the video man will set the f-stop for each particular set-up.

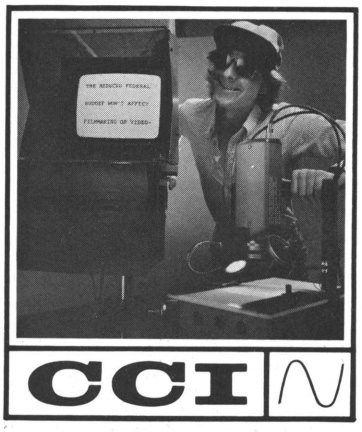
Normally with video it is considered advisable to set the white level so that face tones will be about 80% of peak brightness. In most studio conditions this is usually feasible, although there may be in-

stances where it could be difficult. If a performer, for example, is wearing a shiny white satin dress, it is possible that setting the video gain to bring the white of the dress down to the proper level may result in dark face tones. In a case like this some kind of compromise is necessary. Either the dress must be allowed to exceed the ideal peak brightness or the face will have to appear dark. If the dress does exceed peak white, there will be a loss of detail in the dress, and there may even be blooming or lag if it is hot enough. Fortunately the electronic cameraman does not have to wait for his dailies to come back from the lab to see how bad the problem will be. He can see it right away on a monitor as he is rehearsing the shot.

In addition to setting the white level, the video man has control over two other elements of the video image which may prove useful to the cinematographer in certain situations. He can "raise and lower the pedestal" or "stretch the blacks". These are two distinct alterations of the video signal, and their effects are a bit difficult to describe in words. Raising the pedestal is perhaps most comparable to flashing the film. It increases the average overall brightness of the image without raising the peak of the signal (i.e. without raising the white level). It is similar to turning up the brightness control on a television set. Stretching the blacks is an alteration of the video signal which brings out detail in the shadow areas without raising the pedestal or the black level. Raising the pedestal will make blacks in the scene turn into gray. Stretching the blacks will keep some blacks in the scene at the level of the pedestal, but will increase the separation for tones in the lower end of the brightness range. It is also possible for the video man to alter the gamma of the video signal to produce yet another alteration in the overall look of the image.

Light Levels

Some electronic cameras can operate well in light levels as low as 10 to 15 fc and yield acceptable images. Generally this is accomplished by boosting the gain, and generally 125 to 150 fc is considered a normal light level for studio electronic cinematography. Some television technicians still light a set to 200 or 250 fc just as a matter of habit from the days when video cameras required that much light to function properly. Most cameras today are designed to operate at much lower light levels. George Riesenberger, another staff lighting director with Imero Fiorentino Associates, shot a test at one footcandle, literally using one candle one foot from the camera and got an image. The lowest light



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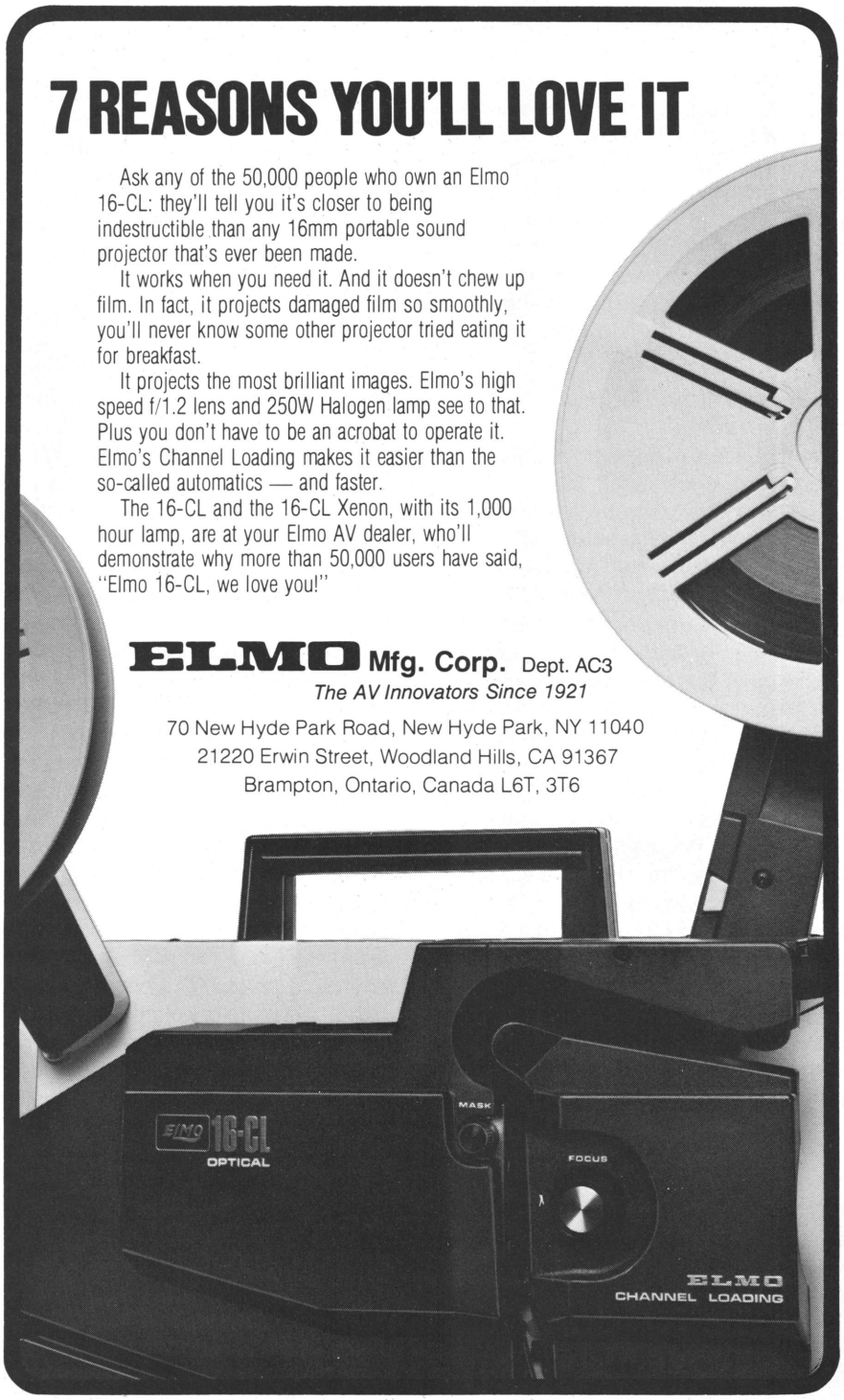


level he has actually worked at however is 10 fc, and that was for a camera demonstration at a National Association of Broadcasters convention. Generally the only time a cameraman would work at light levels this low is in taping a stage show or some other event wnere he had no control over the lighting. When Bill Klages was called upon to light Leonard Nimoy's one man show on Van Gogh for videotaping, he was faced with the problem of incorporating images projected onto a screen behind Nimoy. Since it was not feasible to brighten the images on the background screen, it was necessary to light Nimoy at 15 footcandles. He was able to do this, and the show was successfully recorded on tape.

The choice of a light level may be determined by how much depth of field is required just as it can be with film. Specifications for a typical electronic camera will list its sensitivity as 200 fc at f4 or roughly the equivalent of shooting with a film having an ASA rating of 100. To push beyond that speed would require boosting the video gain and some news cameras claim to be able to produce usable images at levels as low as 6 fc.

Highlight Detail

One thing worth noting in comparing the latitude of film and video is that a television image originally shot on film and then transferred to tape can sometimes show more detail in highlights than the same scene recorded directly on tape. Although any telecine system used to broadcast film or transfer it to tape has a 30:1 contrast ratio just like a live camera, sometimes there can be compression of highlights in a film image due to the "knee" at the top end of the H & D curve. It is possible for highlight detail which would be outside the range of an electronic camera to be captured on film and compressed so that some or all of the detail in the processed film image would fall within a 30:1 contrast range. This would mean that the detail could be preserved when the film image is converted into an electronic image. Some electronic cameras now have circuits which attempt to duplicate the highlight compression caused by the "knee" in a film curve, but none of them can achieve the 100:1 contrast ratio of film.

The difference between a 30:1 and a 100:1 contrast ratio may sound more drastic than it is in practice. It is probably only in extreme situations that the cinematographer is going to feel restricted by what he can do in lighting for tape. He may need to put slightly more fill light into shadow areas of a low key scene than he would with film, or he may have to be more careful about hot spots in the frame; but basically he can still achieve the same kinds of lighting effects with tape that he does with film.

Color Balance

Lighting for video must involve the same considerations of color temperature as lighting for film. Electronic camera control units are generally equipped with a switch which can be set for daylight or tungsten light. Rather than filtering the light as it enters the lens or changing to a different film emulsion, the operator of an electronic camera can adjust the color balance of his image by adjusting the amplification of the three color signals. He can also use a filter in the same way a film cameraman does.

The fact that an electronic camera generally involves a beam splitter and processes the color components of the image separately provides the cameraman with a very powerful tool for controlling color in electronic cinematography. One of the members of a video crew is the video man whose responsibility it is to insure appropriate brightness levels and consistent color balance in the signal being generated by each camera. If the cinematographer can communicate effectively with his video man, it is just like having a timer from the lab on the set giving him instantaneous reports on the lights at which the scenes are printing. In many instances the video man can correct problems on the set which a timer would be hard pressed to correct in making an answer print.

For example, video productions which are esentially stage shows or concerts often have to use a follow spot with a different color temperature from the rest of the lighting. Sometimes it is not possible to filter the spot light without cutting the light too much. In many instances the color balance of the camera can be custom tailored to the situation and results can be achieved which would be very difficult to achieve in timing a negative. Similarly video productions often involve the use of dimmers to control all the lights, and the color temperature of the lights may vary when they are dimmed. It is possible to compensate for these variations by adjusting the levels of each of the color signals in the camera for each new set-up.

The ability to custom tailor the color balance of an electronic camera can be used creatively as well. Color effects which might normally be achieved to filtering the lights or the lens can be accomplished electronically by the video man. One advantage this technique offers is the ability to slightly alter the color effect from one set-up to the next with great case. Greg Brunton, for example, introduced a sepia effect into a sequence in a video production by having the video man electronically "paint" the scenes. He was able to use a more saturated sepia effect for wide shots and a less saturated effect for closer shots simply by having the video man tweak a few knobs at every set-up.

In addition to the color balance and the brightness level, the video man can also vary the contrast or the gamma of the image, in the same way a home viewer can adjust the contrast on his receiver. While the video man will normally set the gamma for certain specifications which are considered standard, there is no reason why the ability to control this aspect of the image cannot be used creatively by the cinematographer as well. As Anton Wilson is fond of pointing out, electronic cinematography is really like being able to have a custom made emulsion for every scene. The speed, contrast, and color balance can be modified to help achieve whatever effect the cinematographer desires. In a sense "lighting" for video involves electronic manipulation of the image after is it captured by the camersa as well as the use of lights, filters, scrims, cutters, etc. on the set.

The Video Man

It should be clear that while lighting for video can be governed by the same principals as lighting for film, there are nonetheless certain tools and working relationships which are unique to video. The working relationship between a cinematographer and the video man is a prime example. The principal tool which the video man uses is a wave form monitor, and any cinematographer who is going to work with an electronic camera should at least be conversant with a wave form monitor.

A wave form monitor is essentially an oscilloscope displaying the wave form of the signal corresponding to each scan line of the image. The screen of the monitor retains the wave form of each scan line long enough for it to be combined with the wave forms for every scan line in an individual frame. What it displays is in effect a cumulative light reading for every spot in the scene with an indication of the color balance. The video man refers to the wave form monitor in order to set levels for peak white and for apparent black. He also uses it to analyze the color balance of the signal. Although many video men understand more about the characteristics of electrical waves than they do about the art of lighting, they can be a powerful ally in achieving specific lighting effects.

The Color Monitor

The second unique tool the cinematographer has in working with an electronic camera is the color monitor. A color monitor can function as instant dailies or as an instant wedge test on every scene. The cinematographer can see what he is getting in a way that is impossible with film. Even with a Polaroid camera the photographer has to wait 60 seconds to see what he got. In electronic cinematography the images are processed at the speed of light. It is essential, however, to insure that the monitor being used to evaluate the lighting is a good monitor which has been properly aligned so that it reflects accurately what is actually being recorded on the tape. An inadequate or improperly aligned monitor can do more harm than good. Also it is important to make sure that anyone attempting to evaluate the lighting is looking at a monitor which is comparable to the one being used by the cinematographer. In many instances the monitor being viewed by a director or producer may be in another part of the studio, and it can look entirely different if it is not properly aligned beforehand. Conversations about lighting between two parties who are looking at inadequate monitors rapidly becomes totally counterproductive. If all the monitors are properly aligned, however, it becomes easier to have intelligent discussions about lighting effects than it is with film. Every cinematographer knows the difficulty of discussing a lighting style on the set with inexperienced producers or directors who can not visualize the difference between the way a set looks and the way the scene will look on film. Generally the cinematographer must simply assure him that it will look right and wait until they can all see dailies in order to find out how the director or producer feels about the lighting. Obviously with electronic cinematography there is no need to explain a lighting effect in words. It is right there on the monitor to behold.

There is of course a drawback to this possibility that many cinematographers may view with apprehension. The ability to see every lighting effect immediately can open the door to lighting by committee and a decrease both in the efficiency of the production and in the integrity of the lighting style. If the cinematographer has the respect and trust of his director and producer, however, he should not be any more hesitant to discuss lighting with the help of a monitor than he would be to discuss it at a screening of dailies. What a good color monitor offers a cinematographer and his director is a means if improved communication and more fruitful collaboration. ■

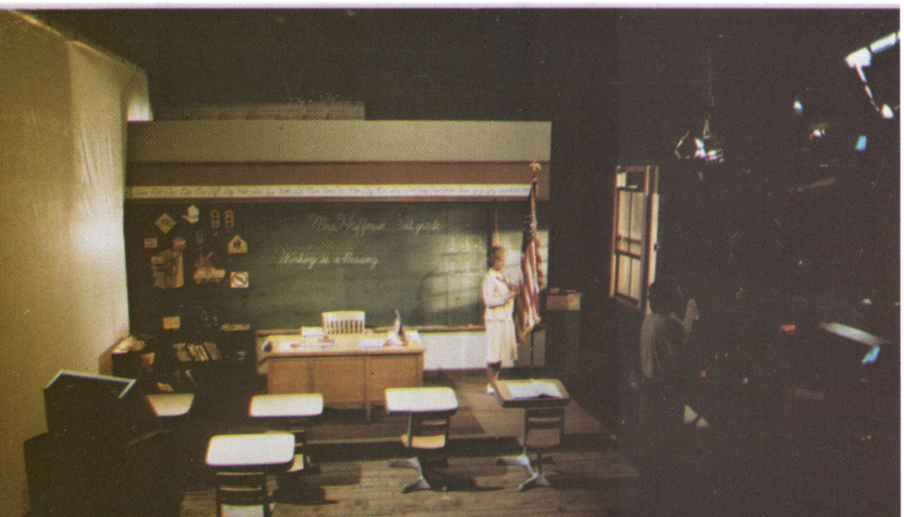
When Greg Brunton lit the Diana Ross special for Home Box Office, the director, Marty Callner, chose an all white look: white sets, white costumes, white floor, even a white microphone. Lighting was used to create color effects appropriate to the mood of each number, and low contrast filters were used on the cameras; but in some cases the combination of a white sequined gown against a very low light level for the background or the audience pushed the video cameras to their limit. Even film has a problem dealing with this kind of contrast ratio.

IFA lighting director William Klages won an Emmy for his lighting of "The Lie," a CBS Playhouse 90 drama by Ingmar Bergman starring Shirley Knight and George Segal.

LIGHTING DESIGN FOR "WORKING"

"Working is a 90 minute adaptation of a stage musical based on Studs Terkel's book of interviews with people about their jobs. Produced for the PBS series "Playhouse", it was taped at KCET in Los Angeles with a 7 day schedule. Director Kirk Browning and lighting designer George Riesenberger are seen here discussing a scene in which Rita Moreno is a waitress waiting on Studs Terkel, played by himself. The scene called for Rita Moreno to be fully lit as she moved among the tables singing, but for the customers at the tables to be backlit or darkened; and it was shot with four isolated cameras. Riesenberger used a down light for each table and two 2K ellipsoidals as follow spots for Moreno, but softened the edges of the ellipsoidals to avoid the look of a follow spot. The set also included a scrim with additional people at tables behind the scrim who were lit at various points during the scene to increase the sense of depth.

For a scene in which Fausto Barajas played a migrant worker, Riesenberger created the sun and the cloud effects by light on the cyc using two 5K's with an orange gel to create the sunburst (one spotted and the other in a semi-flood position) and two ellipsoidals with yellow gels to create the cloud patterns. There was a single 10K back light for the entire set with an orange gel to give the strong single shadow. The amber effect on the bottom of the cyc was created by combining a double #12 yellow and a #26 red on the strip lights in front of the cyc and balancing them with the dimmer while checking a color monitor to determine the result. The house is a photomural about 15 feet in front of the cyc, and it was lit by a 5K with a #17 flame gel barndoored off the rest of the set. The actor in the foreground was lit with a separate 2K back light and a single 2K fresnel key. There was also a 1K fresnel fill light on the side with a light amber gel. All the lighting units were hung from a counterbalanced grid system above the set.

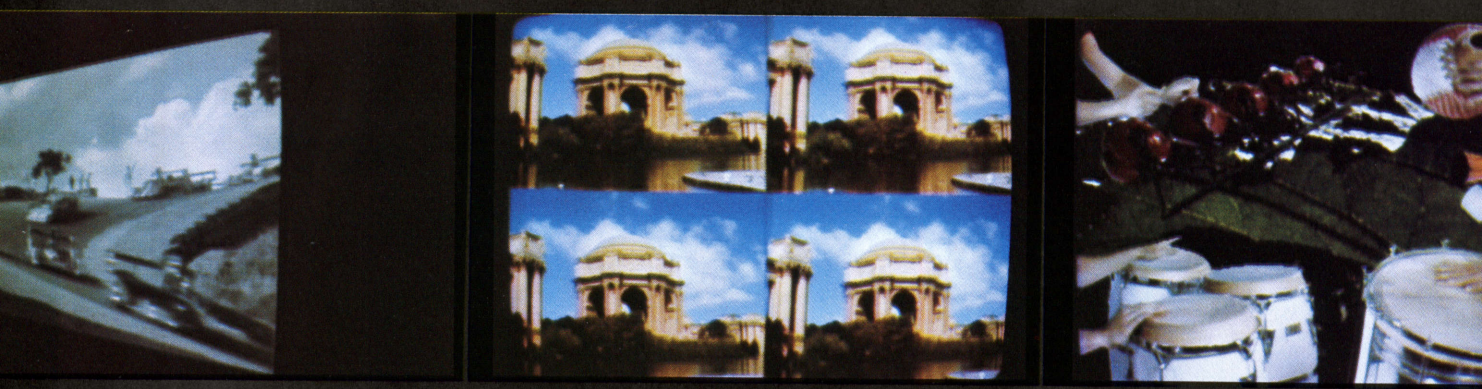


Barbara Barrie played the teacher, and the scene called for her to sit at her desk, walk to the window and then walk back to sit down in front of her desk. Her key light was a 5K coming through the window, but this was flagged off of the blackboard and a separate 2K ellipsoidal was used to create the window pattern on the board. Three 4K soft lights provided a general overall fill. There were two main keys covering the areas through which the actress moved, and additional backlight. As with most of the scenes, there were three cameras shooting different angles simultaneously. There is a scrim on the left with some background behind it which was lit during a portion of the scene.

A scrim was used again in the set for the supermarket scene. Behind the scrim are photomurals and a few props and actors moving through the background. The set used practical flourescent lights both in front of and behind the scrim. The flourescent bulbs provided some of the lighting for the set and were seen on camera. Riesenberger used 3350°K bulbs and had the cameras balanced to correct the color of the light. The video man was concerned because of the streaking caused by the flourescents when they were included in the shot, but it was decided that the effect was appropriate for the look of the scene. In order to preserve the flat bright look of a supermarket, Riesenberger ringed the entire set with 5K fresnels with frost at a low angle. There was some back light for the main action around the check out counters, but there was no key light strictly speaking. The set included the exit and entrance to the market and there was action outside which was lit with 5K fresnels and 5K back lights to simulate a bright sunlit day. The light blue on the cyc representing wall of the market was created by combining #80 blue with clear light from both top and bottom of the cyc.

The steel mill set was actually used for three different sequences and lit differently for each. It was a structure of tubular iron with the ceilings and three walls covered with Flexiglass frosted material. To create the warmth of the hot molten metal in this scene where Barry Bostwick played a steelworker, amber light was used behind some of the frosted panels. There was an ingot which was a prop with lights inside, and the sparks from the welding torch were supplemented with irregular flashes of light from banks of photofloods on the side of the set. The practical lights in the set were brought down on the dimmer, and the overall light level for the set was only about 75 fc. For most of the sets the average light level was under 100 fc.

The kitchen was part of a dual set with an exterior outside the door which was used for part of the scene about the housewife, played by Beth Howland. In order to create a sense of the bright daylight outside the kitchen, Riesenberger placed a scrim material on the windows and doors and lit it extremely hot. The video man again expressed concern about the light level in the windows, but the look of the lighting effect was considered more important than any technical considerations about clipping of highlights in the window and door. The set was lit with a wash on the walls that permitted them to be made any intensity desired. In addition fresnels were used to light the bottom portion of the walls to simulate the light coming through the window. Soft lights were used to provide a general overall fill, and a single key for the actors at the table was placed to the left of the camera.



A DIGITAL EFFECTS SAMPLER FROM ONE PASS OF SAN FRANCISCO

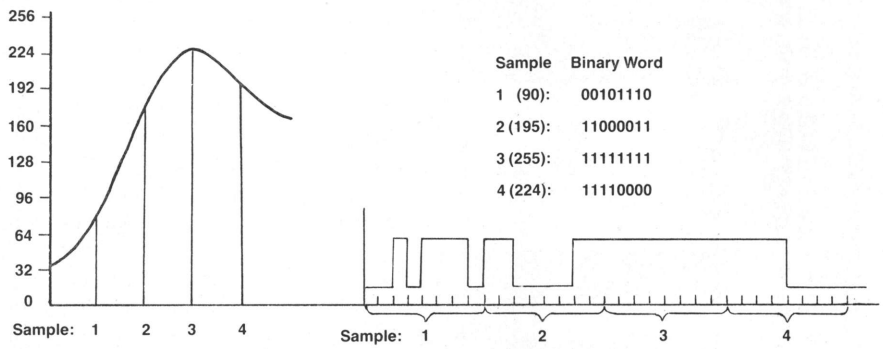
(TOP ROW) Optical Reposition—Push on frame (SECOND ROW) Posterization and Mosaic (THIRD ROW) Perspective, Quad Split and Aftermatte (FOURTH ROW) Graphic Animation and Flare—Independent matte elements with flare effect (BOTTOM ROW) Ultimatte—Independent foreground/background materialization.

A LAYMAN'S INTRODUCTION TO DIGITAL VIDEO

There is a lot of excitement in some quarters these days about The Digital Revolution in television. For the filmmaker who has only recently decided that electronic technology may have something to offer him, discussions of digital video may seem simply to be heaping coals on the fires of his confusion. He probably couldn't care less whether a video signal is analog or digital so long as he gets what he wants on the screen. Nonetheless it may be useful to have some rudimentary understanding of digital video technology. The more one understands a tool, the better one is able to use it; and, if nothing else, a filmmaker may feel more comfortable in a video facility if he can understand a little bit of the language being spoken there.

The term "digital" refers to a method of converting information into an electrical signal alternating between two fixed levels which can be thought of as "on" and "off" or "1" and "0." Computers as a rule process information digitally. The key to digitization is the translation of information into "words" composed of 1's and 0's, i.e. the conversion of everything into binary numbers. Binary numbers are composed of only two digits (0 & 1) so that counting from zero to ten would go 0, 1, 10, 11, 100, 101, 110, 111, 1000, 1001, 1010. While a number system based on ten digits is much handier in everyday life, a binary number system connected to an electrical signal can accomplish wonders. For example by assigning a specific binary number to each letter of the alphabet and to each normal decimal number, it is possible to convert all manner of information into electrical signals which can be recorded and manipulated by on/off switches in complex circuits.

The individual signal (i.e. a "1" or "0") is called a "bit" (condensed from *bi*nary dig*it*), and most computers work with eight bit "words" called "bytes." When someone talks about a "megabyte," he is talking about a million bytes of 8 million bits of "information." With eight bits there are 256 different possible combinations (2^8), and most computers are designed so that eight bits can be transmitted simultaneously. This is called parallel transmission as opposed to serial transmission in which the bits are transmitted one after another over a single line with an indication of the beginning and end of each byte.



Digitization of an Analog Signal

Digital vs Analog

To understand how all this can be applied to a television signal, we must first understand the difference between an "analog" signal and a digital signal. Generally speaking an analog signal is a continuously variable signal rather than a series of discreet pulses at fixed levels. An audio signal created by a microphone is a continuously varying electrical signal the "shape" or characteristics of which are analogous to the "shape" of the sound wave. Similarly the video signal generated by a pick-up tube is a continuously varying signal in which the amplitude corresponds to the brightness level of the image at a given point on a particular scan line. All video signals (like all audio signals) originate as analog signals, but it is possible to convert them into digital signals. This is done by analyzing the signal as a series of discreet voltage levels occurring one after the other. Just as a curve on a graph can be analyzed as a series of points having definite values, the changes in the amplitude of a video signal can be analyzed as a series of distinct voltage levels. The ability to reproduce smoothly and accurately the shape of a curve on a graph depends on the number of points selected. Similarly the quality of a digital video signal depends on the "sampling rate" or the frequency with which the voltage level is measured. Generally the sampling rate for a digital video signal is greater than 12 million times a second.

Each time the video signal is sampled, the voltage level of the signal must be translated into a digital "word" which can then be transmitted. If the system is designed to use an eight-bit word, it can distinguish between 256 levels of amplitude (or levels of brightness in the image). This is sufficient to achieve an accuracy which is the equivalent of a 56 dB signal to noise ratio and comparable to the quality of the analog signals currently being used. Increasing the number of bits per word complicates the processing of the signal but greatly increases the resolution. A nine-bit word could distinguish between 512 levels of brightness.

Composite vs Component Signals

There are two forms of digital video signals: composite and component. A composite signal is one which includes color information along with the brightness or

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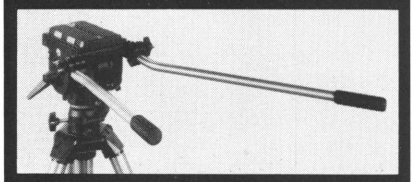

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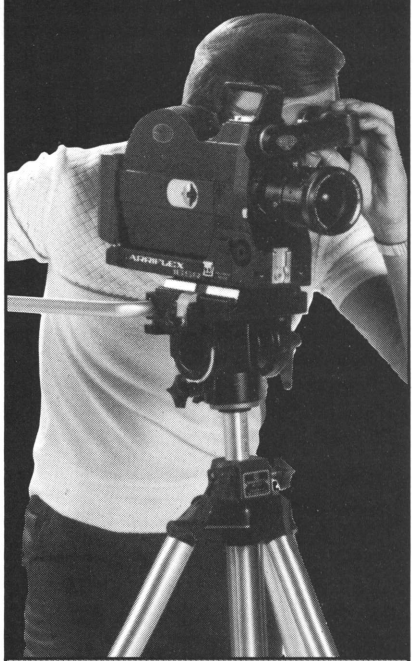

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"luminance" information in the way a composite analog signal does. It is made from the analog signal after the color has been encoded onto the luminance signal. A component digital signal is one in which the color information is separate from the luminance information and is either made directly from the color signals from the three pick-up tubes or made by separating the color information out of a composite analog signal. A component digital signal must have a separate series of bits for the color information, but the sampling rate for the color information does not have to be as great as the sampling rate required for the luminance component. The color sampling rate can be somewhere in the neighborhood of 4 million times a second.

Advantages of Digital Signals

What is gained by converting an analog video signal into a digital signal? The primary virtue of digital signals as compared with analog signals is that a digital signal is not subject to distortion or degradation when it is processed or reproduced in the way an analog signal is. Everytime an analog signal is re-recorded or processed in some way there is likely to be an increase in noise in the signal. This is not true of digital signals. On is on, and off is off and there is no gray area in between to get muddled. This is why there has been so much interest in digital sound systems since there would be virtually no loss of quality during the processing which takes place between the recording microphone and the playback speaker.

Moreover, digital information can be stored in a "memory" in such a way that it is possible to have random access to any portion of the information. If we think of the television image as a series of discreet picture elements (sometimes referred to as pixels) arranged along horizontal scan lines, we can visualize the memory of a digital video system as an array of pigeon holes corresponding to scan lines of the image. Each pigeon hole would contain a byte indicating the brightness of the image at that point, and we could alter the contents of any pigeon hole without affecting the others.

Time Base Correction

The ability to store or delay portions of a digital video signal makes possible corrections in the timing of the various elements of the signals, and the time base corrector was the first piece of video equipment to make use of digital technology. Because of the speed at which everything occurs in a video signal, timing of the synchronization pulses is extremely criti-

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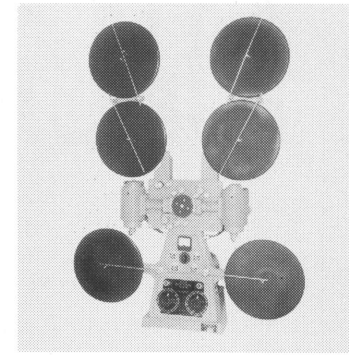

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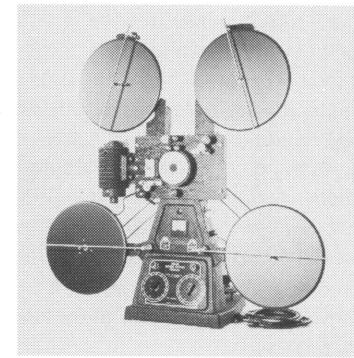

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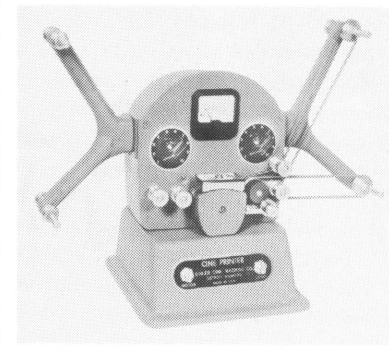

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cal. The problem with time base errors is greater with helical recorders than with quad, and it was the development of digital time base correctors that made possible the widespread use of 1" and ¾" helical videotape recorders. Without a time base corrector a recording made on a ¾" recorder in the field might not be compatible with the equipment in the studio.

Digital devices can also correct other problems with a video signal such as variations in the speed of the scanning of a line of the image, dropouts or noise in the image and improper color balance.

Storing a frame digitally can be used to create freeze frames, or it can be used to store an entire library of still images on a random access magnetic disk. Putting a video signal into a digital form facilitates the conversion from one standard to another. A computer can look at a 525 line NTSC signal in a digital form and figure out the equivalent 625 line PAL or SECAM signal. As a result digital standard conversion equipment has greatly amplified the foreign distribution of programs on videotape. Digital manipulation of the image also makes possible a variety of image enhancement techniques useful in making tape to film transfers. The Image Transform system makes use of computer manipulation of the video signal in order to obtain the best possible image on film.

Digital Special Effects

By far the most impressive applications of digital technology, however, are the creative uses to which it has been put in digital special effects equipment and digital graphics generators. Once an image has been digitized there is virtually no limit to the ways in which it can be manipulated. For instance it is easy to see that by removing every other pixel, the image could be reduced to fill only one quarter of the screen. Using the computer to extrapolate intermediate points enables a digital image to be enlarged, and a sophisticated enough program can produce a continuously variable image size, i.e. a zoom on an existing frame of video. Two or more frames can be reduced and combined into a multi-image frame. A reduced frame or a portion of a frame can be relocated anywhere on the screen or rotated. The entire frame can be made to appear to turn on an axis three dimensionally. You name it, a digital special effects generator can probably do it. Any special effect that can be done on an optical printer can be accomplished electronically with a digital special effects generator. The capabilities are so vast that there is a problem developing a jargon for describing even a fraction of the effects that can be done. In addition to zooms, flips, wipes, freeze frames, push-on/push-off, travelling mates, strobe effects, etc. it is possible to play with the color and brightness and contrast and polarity in ways for which there may not be a corresponding effect in film. And all of these effects can be done in "real time" assuming the operator can figure out which button or combination of buttons to push. An effect can be previewed almost as quickly as it can be imagined. In some cases an effect may be previewed that never could have been imagined.

Digital Graphics Generators

By comparison digital graphics generators may seem a bit mundane—until you begin to explore the possibilities. The simplest graphics generators are ones for burning type into an image. Most sophisticated video editing facilities now include a character generator offering a wide variety of type faces which can be generated in any number of sizes and positioned anywhere on the screen. The letters can also be colored as desired and given a drop shadow. The next step up in video graphics equipment is a set-up that enables one to "draw" on the screen by hand, using a stylus on a plotting board which translates the movements into the appropriate video signals. Similarly it is possible to "hand color" video images with a digital graphics generator. Graphic images fed into a sophisticated graphics generator can be manipulated in any number of ways, and here again the possibilities begin to boggle the mind. One of the most impressive achievements of computerized graphics generators is the ability to translate design drawings into three dimensional renderings with proper perspective and color shading. The rendering can then be rotated through 360°. Computer graphics is an entire industry unto itself, and digital video techniques enable all of the capabilities of computer graphics to be applied directly to a video image.

It is generally assumed that digital video signals will eventually replace analog signals in virtually every stage of video production and distribution between the pick-up tube and the receiver or projector. Recommendations for high definition television systems all include the recommendation that the greatest possible use should be made of digital techniques. There are still obstacles to practical digital cameras and digital transmission of television, but the transition to digital television has already begun in post-production facilities and will continue to spread throughout the electronic production and distribution process. ■

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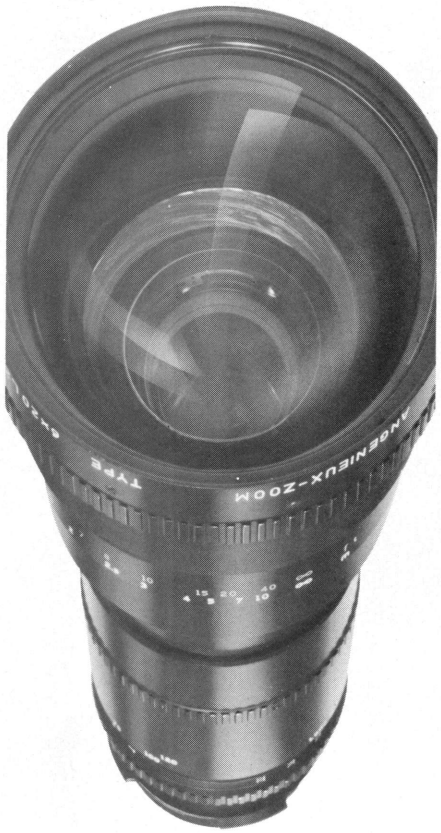

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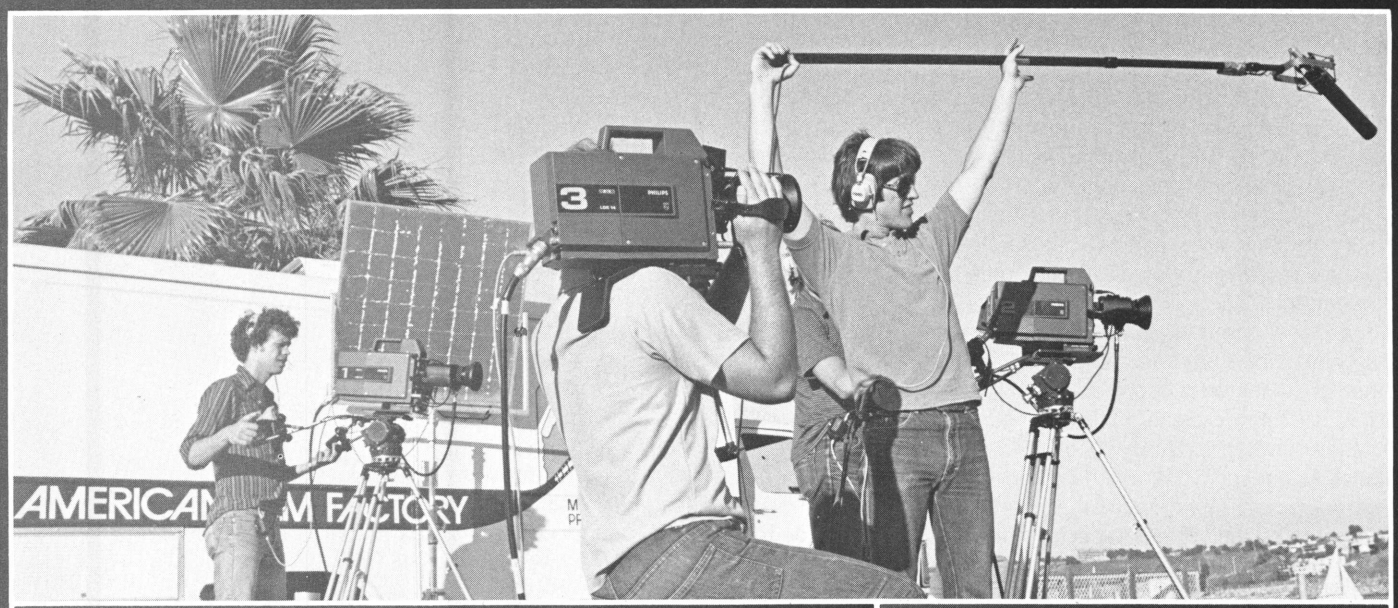

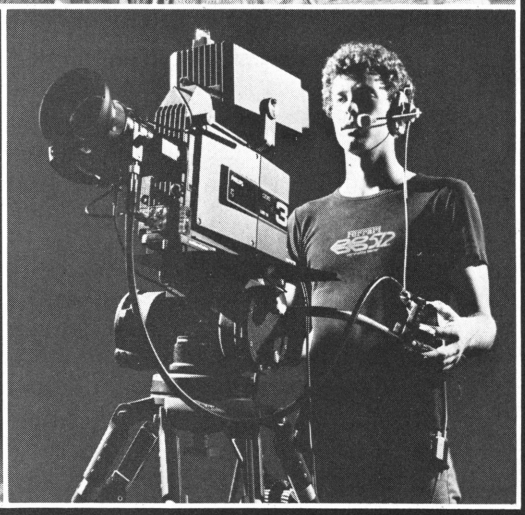

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PAP

POST AUDIO PROCESSING

By STEPHEN POTTER & RICHARD PATTERSON

One strong hesitation a filmmaker has in approaching an electronic video production is the limitations he feels he will face in the control over the sound track for his program. Until very recently the techniques for the creative use of sound and for the level of quality control that a filmmaker is accustomed to in his sound post-production were not readily available to an electronic production. Because of its association with news or "live" events and also because of the inherent limitations in the sound quality possible on the speaker in most TV sets, television production has traditionally accepted much lower quality on the sound track. Work on the sound track was generally limited to "sweetening" i.e. adding a very limited amount of additional sounds to the production track.

Now however things have changed, and it is technically feasible to do with video equipment and multi-track audio recorders virtually everything a film sound editor and mixer does. In fact video sound facilities have been able to go film techniques one better such that in some areas electronic techniques exist which can do more than is possible with traditional film techniques or do the same things much faster. Techniques employed for post-production work in video can be used to great advantage in conjunction with a film production, and will be utilized to an increasing extent as filmmakers realize what the new technology can do for them.

For someone accustomed to the multi-track recording techniques used in the music industry, traditional film sound techniuqes seem to appear hopelessly behind the times. Film sound work involves relatively cumbersome equipment and relies to a large extent on mechanical rather than electronic procedures. One reason for this has been that film sound work involves a unique problem which until the

A state-of-the-art computerized sound facility at Glen Glenn in Hollywood using multi-track recorders for film and video post-production.

The PAP pre-lay room in which sound effects are laid down onto a 24 track tape in sync with a 3/4" videocassette according to a log on the floppy disk from the spotting session.

Studio T at Glen Glenn is being used to mix sound for "The Greatest American Hero" on a multi-track audio recorder synchronized with a ¾" videocassette machine. Normally only one mixer is required for track sweetening in a video production.

mid-1970's was best solved by a mechanical means: that of maintaining sync between the sound tracks and the picture. Sprocket holes and some kind of interlock between the film transport and the audio machines were really the only feasible way of working—until the development of SMPTE time code for videotape.

The time code in use today was developed by the SMPTE and was adopted as an American National Standard (ANS V9812) over several other types of code in use at the time. This was in the early 1970's, the actual date of adoption as a standard being in 1975. So in essence, the means of providing absolute synchronization between non-sprocketed tape recorders is still in its infancy compared to the much older standards the film industry has been using. SMPTE time code is a digital type of code containing a continuous series of numbers expressed as hours, minutes, seconds and frames which is recorded as something comparable to an audio signal on the 2nd audio track of the videotape machine (or with some machines a special SMPTE code track) and on a track of the audio tape machine to be synchronized. Developed as a means of facilitating electronic editing of a videotape, very soon it was realized that the time code provided the means for maintaining sync not just between two or more videotape machines but also between a videotape machine and a multitrack audio tape recorder. This opened the door to a whole new procedure for editing and mixing sound for film and television. Various systems have been developed and of those the Post Audio Processing (PAP) system developed by Glen Glenn Sound in Hollywood was one of the first and is certainly one of the most sophisticated in its present form.

Post Audio Processing represents an alternative method to the traditional tasks of film sound post-production (i.e., music and effective spotting; effects and dialogue cutting; and special control over sound elements). Originally developed to be an economical alternative, as multitrack recording technology and video computer-assisted editing technology have grown, PAP has grown, too and become a creative choice rivaling the long standing techniques pioneered for film sound enhancement. Designed as an aid to a film production and intended to be used for film dubbing, since it was really an outgrowth of the video "pre-lay system" (to be described later), the PAP system is finding increased use as a valuable tool to many electronic video productions as well. Although the potential of the system is only beginning to be tapped, for the film production it is capable of doing virtu-

(LEFT) This is only a portion of the sound effects library in the machine room for Studio T at Glen Glenn. The effects here are on NAB tape cartridges. (RIGHT) The spotting room for the PAP system contains the computer floppy disk drive and the printer which logs all the sound cuts.

In	Out	Item	Action	Source Track Footage
2:00:12:00		POP	SRC1	18
2:00:13:10		FIRST FRAME	SRC1	20
2:00:13:10	2:00:54:04	ELEGANT CAFE WALLA	SRC1	20- 81
2:00:13:10	2:00:54:04	GLASS CLINKS	SRC1	20- 81
2:00:13:10	2:00:54:04	COUGH & SCUFFLE	SRC1	20- 81
2:00:13:10	2:00:31:11	< A DIALOGUE	SRC1	20- 47
2:00:31:11	2:00:32:22	FILL A >	SRC1	47- 49
2:00:31:22	2:00:34:20	< B DIALOGUE	SRC1	47- 52
2:00:34:20	2:00:42:21	< A DIALOGUE	SRC1	52- 64
2:00:39:21	2:00:40:06	FILL A	SRC1	59- 60
2:00:42:21	2:00:44:12	B DIALOGUE	SRC1	64- 66
2:00:44:12	2:00:50:26	< A DIALOGUE	SRC1	66- 76
2:00:50:26	2:00:54:04	FILL A	SRC1	76- 81
2:00:54:04	2:01:01:25	NITE LITE TRFC	SRC1	81- 92
2:00:54:04	2:01:01:25	LITE WIND THRU TREES	SRC1	81- 92
2:00:54:04	2:01:01:25	CRIX	SRC1	81- 92
2:01:01:25	2:01:24:17	O/S NITE LITE TRFC >	SRC1	92- 126
2:01:01:25	2:01:24:17	O/S CRIX >	SRC1	92- 126
2:01:01:25	2:01:20:19	TO FX	SRC1	92- 120

A sample print out from the floppy disk of the log generated during a PAP spotting session. In and out times are indicated by SMPTE time code and automatically converted into film footage for the reel. The source column indicates what machine the effect is coming from and is for use in the pre-lay or sweetening session when the actual effect is chosen and lined up. A print out from the floppy disk provides a permanent record of all the decisions made in the sound editing process.

ally everything that an effects editor could want to do as well as being extremely useful and cost effective to totally electronic productions.

The best way to understand the potential of the system is to take an imaginary production through all the phases of its sound post-production work using the system. First of all let's consider how we would use the system if our production originated on video tape. Later on we shall see how all these procedures can be used for a film production. And let's do our sound work with the same care and attention to detail we are accustomed to in film sound post-production. Most videotape productions do not demand the same level of quality control and creativity in sound work as we might normally bring to bear on a film production, but we are not going to lower our standards just because we are working in a different medium.

Editing the Production Track

As with film the real post-production work in sound begins after the picture is "locked" i.e., after we have finalized all our decisions about picture editing. In our videotape production this phase of the editing has probably been accomplished in an "off-line" editing session using ¾" dubs of our 1" or 2" original videotape. The dubs should have the SMPTE time code displayed in the picture area to aid our work (like constantly visible edge numbers). The sound on the ¾" dubs is not good enough to satisfy our standards, though. This is one difference between film and videotape sound procedures. The work track used in editing a film may be used in dubbing as well; but the sound recording characteristics of our "worktrack" in video (i.e., the tracks on the ¾" dubs) do not have adequate wow and flutter specs, and there may be crosstalk from the time code signal which is of necessity recorded very hot on the second audio channel of a ¾" cassette. We want to be able to work with a better transfer from our production track. Since the production track is on the same videotape as the original picture, the easiest and most customary procedure is to edit the original sound electronically as we edit the picture in the "on-line" editing session. Sync dialogue production tracks are edited right along with the picture in the on-line editing session and a certain amount of sound editing can be done then as well. We could put in overlaps or voice-overs from the production tracks while we are editing the picture, but we want to stay away from too much sound editing during the on-line editing because of the expense. There is no need to tie up all the picture editing equipment and personnel while we do sound editing. So what we do is edit the production tracks to match what was done in the off-line editing and end up with the equivalent of the single track of dialogue that a picture editor normally turns over to the sound editor along with a dupe of the work print. We should, however, go into the on-line editing session with notes about all the bits and pieces of track we are going to need from the trims and out takes. Since our production tracks are on the videotapes, they are not as accessible as they would be on ¼" audio tapes. It may then be well worth our while to dub off what we need onto a ¼" tape as we have each reel up for editing.

The edited production track then is actually transferred or "laid down" to a 15 or 24 track tape from the edited master 1" or 2" videotape at the same time the ¾" video dub is made. Most importantly, the SMPTE time code from the master videotape is transferred during this dub to one track of the multi-track audio tape (usually track 24) and to the 2nd audio track of the ¾" videotape. We shall assume that we are going to use 24 track tape format for all our work. In order to protect ourselves from any possibility of crosstalk from the time code signal, we shall leave the 23rd track next to the time code track blank to act as a buffer. That leaves us 22 tracks to work with on that tape. Of course during this dub we transferred the production track onto two tracks (12 & 14 for example) of the 24 track tape. We make two transfers of the production track for safety so in case anything happens to one track we have a backup track. Since we are going to do our final mix onto the same piece of 24 track tape, we really have 19 tracks available to build on. This of course assumes that we will do a standard dialogue, music, and effects 3 "stripe" mix. We mix right onto the 24 track tape that contains all our elements for several reasons. One reason is to end up with a single piece of tape that represents the entire sound track for the production. The main reason, though, is so that we don't need to tie up an additional multi-track machine to mix our 3-stripe onto. This would require additional synchronizing equipment as well as additional multi-track recorders. It also would require that the multi-track tape that we want to mix onto would have to have been pre-striped with the same time code as the original master. This is an additional headache that isn't justified by saving 3 tracks to build our sound track on. If we really need the additional tracks the better approach is to "pre-dub" which we will describe later. It is maybe most important to note that when doing punch-ins or update recording, having all the elements on the same piece of tape guarantees that our mix will be in dead sync with the original

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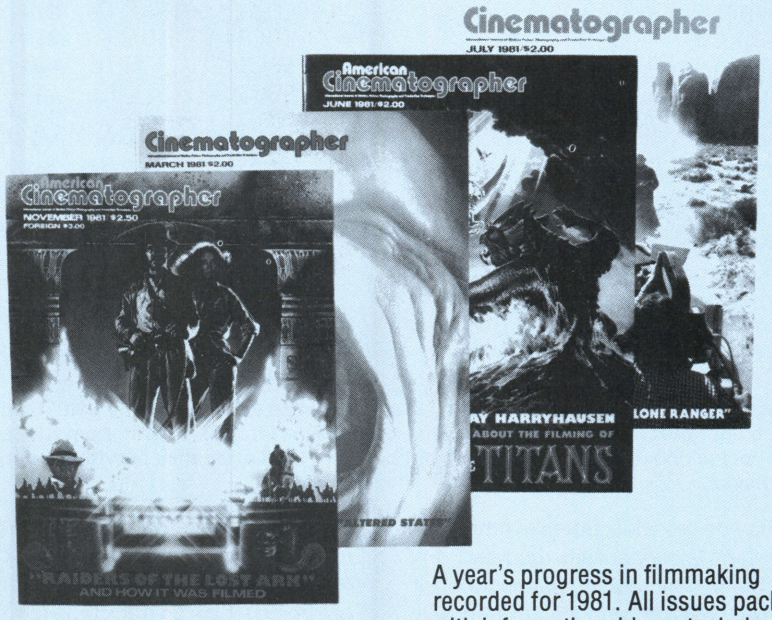

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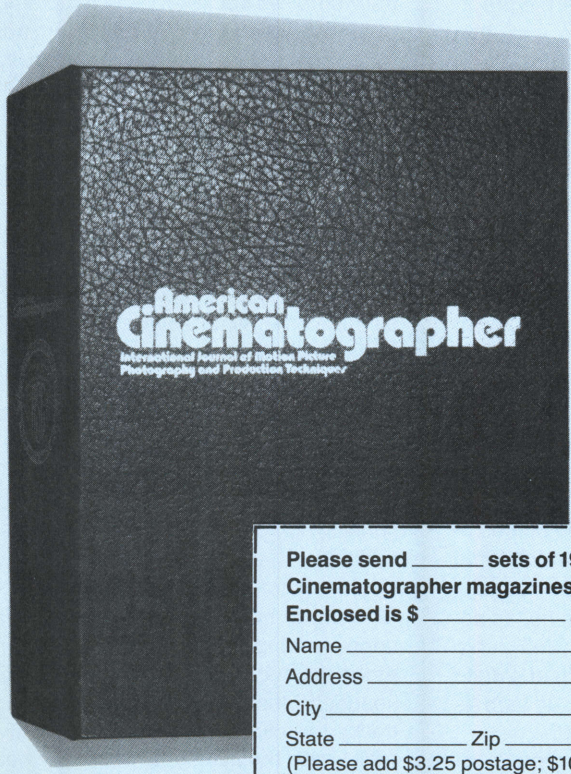

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production track. This is important for if anything were to happen to any of the synchronizing equipment, we could still do a mix without having to worry about losing sync with the production track.

Spotting Music and Effects

So now we are ready actually to begin work on the sound track. The first step is to schedule a viewing with all the necessary people and spot effects and music. We normally do this on a special system called a PAP Spotting System, but it could be accomplished with any ¾" playback system capable of hold frame. We view our show on a video monitor using the ¾" dub of the edited master with the time code displaying in the picture area. If we are lucky enough to have the latest in ¾" playback decks we can fast forward or reverse at up to *40* times speed and still see a usable picture. If we can't afford state of the art equipment, we can look at it on any deck that can do a still or freeze frame and can probably search at about three times speed. The purpose here is to go through the program and find all the time code numbers for dialogue splits, sync effects, background fills, music etc. This can be a laborious process of finding the proper frame with a joystick controller, noting the time code number displayed in the picture for that frame and logging a description of what effect or music or split is to be done. This process is made considerably less tedious by using the PAP spotting system. With this system you can locate the desired frame as described, but you need not write down the time code number by hand and make written notes about it. The PAP computer is able to read the time code for that frame into its memory by pressing one button. Comments may then be entered in a shorthand form through the keyboard of the computer as to the nature of the effect. These shorthand comments are then interpreted by the computer from a dictionary that you have custom entered into the computer into full words which are displayed on a separate monitor (along with the time code numbers). This information is also stored on a floppy disk and can also be printed out on log sheets by the computer with a high speed printer.

Splitting Dialogue Tracks

Our production dialogue track has several different actors on it recorded in innumerable locations, so we want to split up the dialogue to be able to re-equalize them separately when we mix. There are also some production sound effects we want to separate from the dialogue. Although the production track in a video pro-

duction is not normally split up (due mostly to the time demands and lesser concern over quality), there is no reason that it can't or shouldn't be split. So next we plan exactly how we want our "assistant" to break the tracks down. Suppose we want to split the dialogue tracks into three separate tracks and put the production effects onto two others. Whenever we hit a point where we want to split off a track we enter the time code of the frame where we want the cut to occur and of the track to which we want to move the dialogue or effect. When we get to the end of the piece we want to move, we again enter the time code number we see in the frame. When the entire spotting is done we take our floppy disk containing all the time code numbers and comments and turn it over to our "assistant."

With PAP our "assistant" is a computer. All the information from the spotting session is contained on the floppy disk which we plug right into the PAP pre-lay computer. We can give additional information to the computer by typing it in through a keyboard (like a typewriter). The computer runs the 24 track tape machine and splits the dialogue and effects up exactly according to our instructions. This is accomplished in *real time.* There is a limit to the number of events or splits that can be handled in one pass (about 20) but they are done in real time without stopping. Now we are ready to begin the pre-lay session.

Pre-Laying Effects

The terminology of "pre-laying" is mostly used in conjunction with a videotape sweetening session but the techniques are applicable to a film production transferred to tape as well. Instead of transferring and physically cutting sound effects, we shall cue them up and transfer them directly onto the appropriate track of our 24 track tape. When we did the spotting we didn't make any track assignment decisions as to what effects would go on what tracks. So now we step through the program one effect at a time and assign a track for that effect to be recorded on. The pre-lay session takes place in a small room and requires a one man crew. He has a complete sound effects library at his fingertips on ¼" reels or on cartridges which can contain endless loops or single effects which can be automatically cued to the beginning of the effect for quick roll ins. There is a monitor on which we view the ¾" tape of the edited show, and an additional monitor showing a video display of all our effects in and out times as well as the descriptions of them and the track they will be recorded on. We also have a 24 track recorder on which we have

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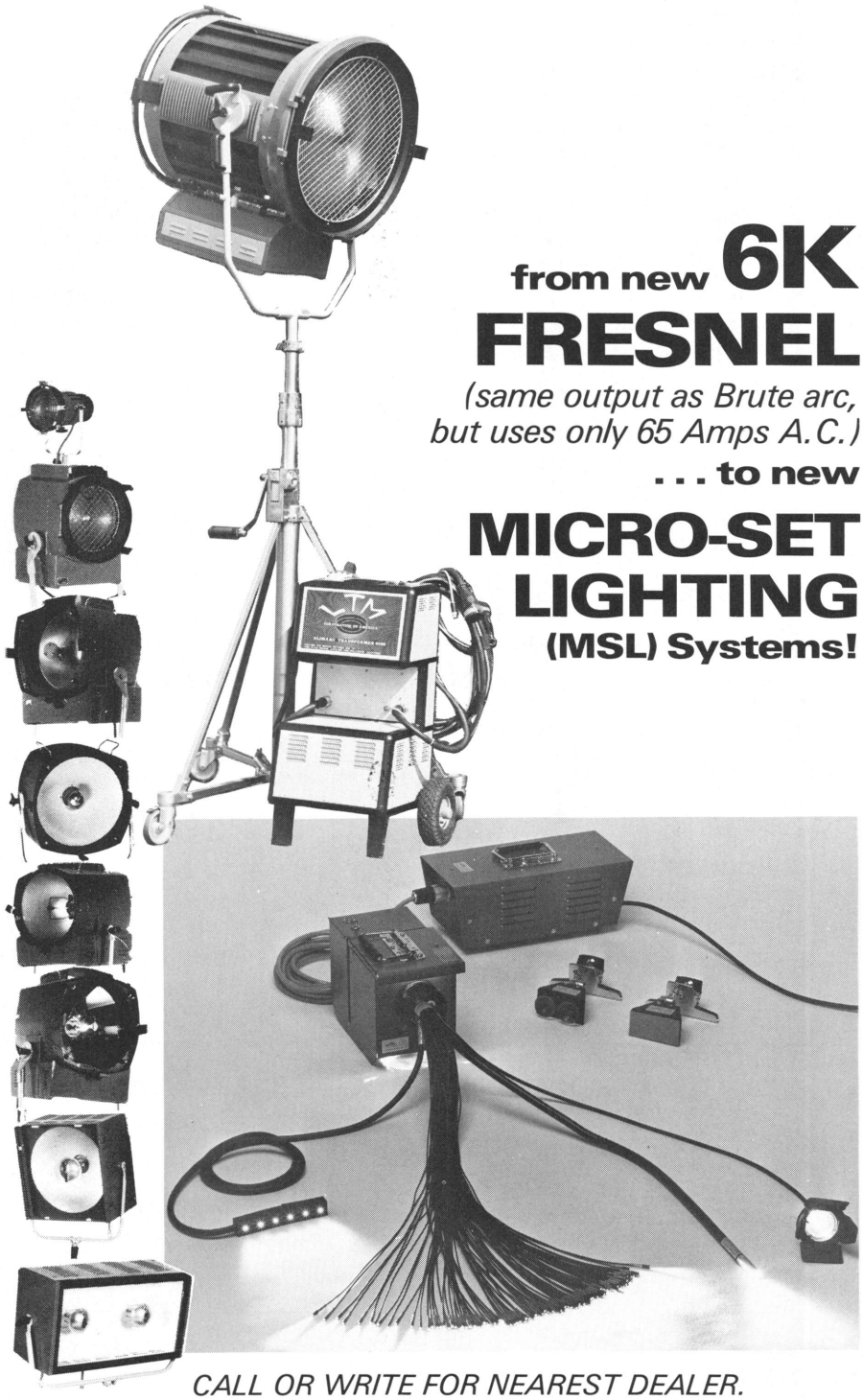

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accumulated a track of time code, three tracks of dialogue, two tracks of production effects and a buffer track for the time code. This leaves us 14 tracks for our pre-laying. (Remember that we need to save 3 tracks for our three stripe mix.) There is a simple mixing panel to enable us to adjust the level of each of the 24 tracks and to do a certain amount of re-equalizing or filtering when we record the effects. There is also a ¼" tape machine and several cartridge machines for rolling in the effects.

We roll down to the first effects cue on our video log "sheet" by instructing the computer to go to that time code number with both the video and 24 track machine. Now we can audition various effects from the library until we find just the right one. If something in the library is not quite weird enough for us, we can call on the variable speed oscillator (VSO) to speed it up or slow it down as much as 100%. Once we've got the sound we want, we cue up the effect on the playback machine allowing for a short pre-roll to let it get up to speed and tell the computer to "cut it in." The computer already knows the time code number for the effect because we have logged it on the floppy disk in the spotting room. But suppose we decide that the time code number we logged isn't what we really want. We can change it by manually typing in a new time code number on the keyboard, or use the same freeze frame one-button technique that we used in the spotting room. We should be aware that this one-button procedure can only be used in conjunction with Vertical Interval Time Code (VITC), which is essentially the same time code numbers we see in the picture but recorded in a digital format on the top part of the picture which can't be seen because of the mask or border around the picture tube of the monitor. The computer can "see" these numbers, however, and read them into its memory instantly with the push of a button. We then tell the computer to back up the video tape and the 24 track tape to give them time to synchronize (usually 2–3 seconds). When we then initiate a play mode the computer gets the video and 24 track machines in sync by comparing their time code numbers and then if sync is achieved it pre-rolls the ¼" tape machine at precisely the right frame (allowing for the exact amount of pre-roll the machine needs to get up to speed) to start recording at exactly the frame we selected during our spotting session. The computer also takes care of selecting and arming the track we selected for the effect to record on, doing the audio patching from the ¼" machine to the 24 track machine electronically. We watch the scene and hear either the effect by itself or the effect along with any combination of what is on the 24 track tape. We have either told the computer in advance when to stop recording just as we told it when to start recording or we can manually take it out of record at a different time (in the case of no out time being specified in advance). If we like what we hear we can move on to the next cue. If we don't like it enough, we can do it again or add something else on another track to sweeten it. If we want to move it up or back just a tad, the computer can adjust it by as little as 1/10 of a frame. If it comes in too abruptly, we can instruct the computer to do a precise quick fade up or fade out. This ensures that with repeated passes the computer will always fade it exactly the same each time. This would be hard to achieve manually. We can also simulate a "scrape" by having the computer do a precisely controlled spot erasure on the 24 track. This accomplishes essentially the same thing as scraping the oxide off a mag stripe. If we are combining two effects and we wish we could make a crossfade to help the transition from one to the next, we can do this by putting the effects on two separate tracks and controlling the amount of overlap in the same way that we did a fade in or fade out. One effect fades in while the other on a separate track fades out. This computer controlled crossfade is repeatably accurate and saves this from being done in dubbing.

Suppose we like what we hear, but before we get to the next cue on our log we have an inspiration about another effect to go in between the one we just did and the next one on our log—or even better to occur earlier in the scene. No problem. We just find the place where we would like to add it, figure out what track to put it on and start auditioning effects until we find the right one or right combination of effects. Then we tell the computer to record them onto the proper tracks.

The advantages of this system are becoming obvious. Not only can we do the actual effects cutting in the same amount of time it normally takes to audition and transfer effects, but we can hear the effect in conjunction with every other element of the sound track as we do it. The cost of doing pre-lay is about $125 an hour, and that includes access to the entire effects library as well as all of the means of modifying the sounds. As we record the effects, we can set the level and the EQ fairly close to what we would want in the final mix. If we record one element in an elaborate montage and then realize after we have

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recorded the others that the first one was not laid down hot enough or has too much high end taken out, then it is a simple matter to go back and re-do it differently. Just cue it up and tell the computer exactly how to do it.

Being able to hear all our tracks as we build them is so exciting that our imagination gets carried away and pretty soon we start wishing we had more than 22 tracks available to us. After all, *Star Wars, Apocalypse Now* and *Black Stallion* sometimes had a hundred dubbing elements for a reel. PAP gives us two alternatives. We can either sync up additional 24 track machines by recording the time code on additional 24 track tapes, or we can do what is probably more realistic and plan for predubs. We could build the elements for one part down onto two or three tracks of another 24 track tape. This way we could build a 24 track tape that represents hundreds of original tracks. The sky is the limit.

We can "cut in" our music cues in the same manner; and, if we wait until the score is recorded before we do our effects pre-lay, we can have the added advantage of monitoring the music as well as the dialogue while we "cut" the effects. The PAP system can also prove very useful in doing some music editing, since it is capable of sub-frame accurate punch-ins and outs. If we want, we can hook up a harmonizer in conjunction with a VSO and change the speed of the music without changing its pitch.

Mixing

After we are done with the pre-lay session, we are ready to mix. Generally what we would have is a single 24 track tape which can be run in sync with a ¾" cassette of the program and which contains all of our dialogue, music and effects. The mix or "sweetening" as it is called in videoese is generally done with one mixer, but the mixing board is every bit as sophisticated as any used for a film; and more than one mixer can be used if the work load justifies it. The 24 track machine can rock and roll in sync with the picture, and we can punch in and out of any track anywhere we want to. We can mix down to separate dialogue, music and effects tracks, and we can mix to stereo. We can do anything one does in a film or music mixing session. If during the dub, for instance, a decision is made to change an effect on one of the channels of the 24 track machine—to "slip" it or move it in relation to the other tracks—this can be accomplished mostly electronically. The particular effect is dubbed off onto a ¼" tape machine with or without the time code on track two. We would use the time code if it was music or an effect which was long and had to stay in absolute relative sync to the picture. In this instance we would instruct the synchronizer for that machine to offset it precisely x number of frames out of sync in relation to the rest of the machines. The effect is then re-recorded on the 24 track tape in its new position. If we didn't need to maintain relative sync, but just wanted to move an effect, then we could roll it in just as we did in the pre-lay session by having the computer on the sweetening stage roll the effect in at a preselected time code number which would represent the new start position for that effect. The computer would also handle the record on and off times based on what we tell it about the new position for the effect. This is about as easy as retarding or advancing a dummy and then putting it back in sync later. If the effect has to be "re-cut" or replaced altogether it is certainly simpler to accomplish this electronically than it is to wait while the track and picture are put into a Moviola for the sound editor to play with.

The final result of the mix is a multi-track tape with a 3 stripe mix which is then "laid back" or transferred in sync onto the edited master videotape. This is done by simply treating the edited master videotape as the master and using the time code from its cue channel to synchronize or slave the 24 track machine with it. (Remember that the 24 track tape has the identical time code as the edited master videotape. This is because the videotape production audio track and time code track were "laid down" on the 24 track tape as described earlier.) Generally a videotape has a single monaural sound track (2" Quad Video) or two identical audio channels (1" Type C Video). This makes the 1" format the only choice for a stereo mix. The edited master now contains our final mix and is ready for duplicating.

Software and Hardware

The secret behind the PAP, Spotting and pre-lay systems is a PDP-11 minicomputer with floppy disk storage and custom designed software (operating instructions to the computer). Since the PAP system is software based, to revise functions and features or to operate the system requires only to modify the software program on the floppy disks and not change the hardware itself. This becomes a cost effective solution to the "keep up with the Joneses" syndrome many recording facilities face due to today's rapid growth electronics industry. Since this is a

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custom system from the ground up, it is indeed quite expensive. However, the sweetening stages at Glen Glenn operate based on a currently available off-the-shelf synchronizer. In its very basic form it "reads" the time code from two machines, one designated as the master, the other as the slave, and controls the speed of the slave to stay in absolute sync with the master. Well, ok, all synchronizers available today have this basic ability. So what sets this system apart from the others? One main feature is the ability to "daisy chain" any number of units together so that many slaves can be synchronized to one master. Most other synchronizers have a limit of one or two slave units which may be controlled by a master. Some other synchronizers can also be tied together to add the capability of more slaves, but the approach is often cumbersome and not economical due to the mainframe design of most other systems. Although it is necessary to have one unit for each slave machine that is used, the relatively low cost (about $4500) compared to the cost of a multi-track tape machine ($30,000 and up!) makes it reasonable to implement. The other main feature is the ability to control it from an external computer, such as the one which controls PAP. This enables custom applications that can barely be imagined. The mixer or operator need no longer be tied to a fixed set of buttons on a control panel to do only what some design engineer imagined would be the most useful functions. It also makes controlling multiple slaves more feasible because the host computer can constantly monitor all the slave units without the operator having to be concerned with them.

PAP for Film

What about this system and its application to a film production? As was mentioned earlier, the PAP system was intended to be for film production, but replacing many of the old procedures of film sound post-production with new multi-track tape technology. The savings are obvious. We no longer need to make any transfers from production sound to mag stripe. But the real savings is in time. We can do the same job much faster as we have seen, and with a higher level of quality. The first step is to transfer a workprint of our film to videotape. There are some important considerations to be kept in mind with this type of post-production, however. The cut dialogue track must be transferred at the same time as the picture so that the time code can be laid down simultaneously on the 24 track tape and the ¾" cassette. If the picture and track are transferred separately, there is no way of guaranteeing sync between the two of them. It is not sufficient simply to add time code to a sound transfer which was made separately from the picture. Transferring simultaneously is really no problem. It is a standard procedure to make a transfer with interlock picture and track. It is just necessary to understand that the time code on the 24 track and the time code on the videotape need to coincide absolutely.

A multi-track tape machine can be electronically locked to "rock and roll" dubbing projectors and run in sync with a whole set of 35mm dummies. This means that the effects cutting could be done on multi-track and the dialogue or music could be on 35mm tracks, if for some reason that was the preferred approach.

There is one precaution which should be taken in dealing with sound for video or video assisted productions. Whenever time code is re-recorded from one tape to another, it should be restored or re-generated rather than simply transferred. The nature of the time code signal is such that it is very susceptible to degradation in re-recording. It is a simple matter to restore or regenerate the time code with a time code reader/generator, and it is essential to do this at every stage. Otherwise you run the risk of having time code which is garbled and cannot be used to hold sync.

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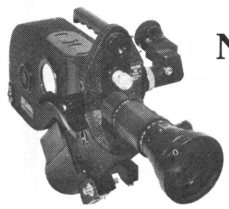
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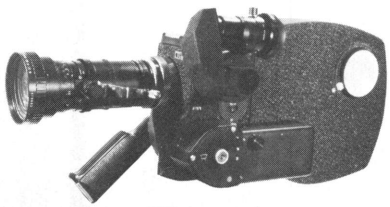

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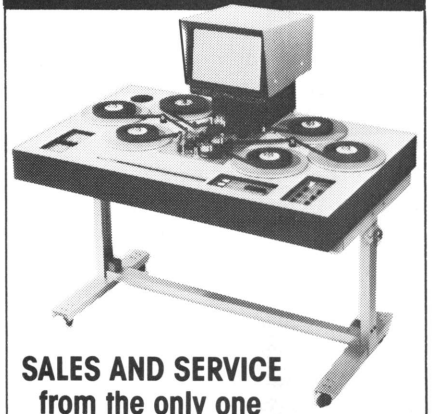

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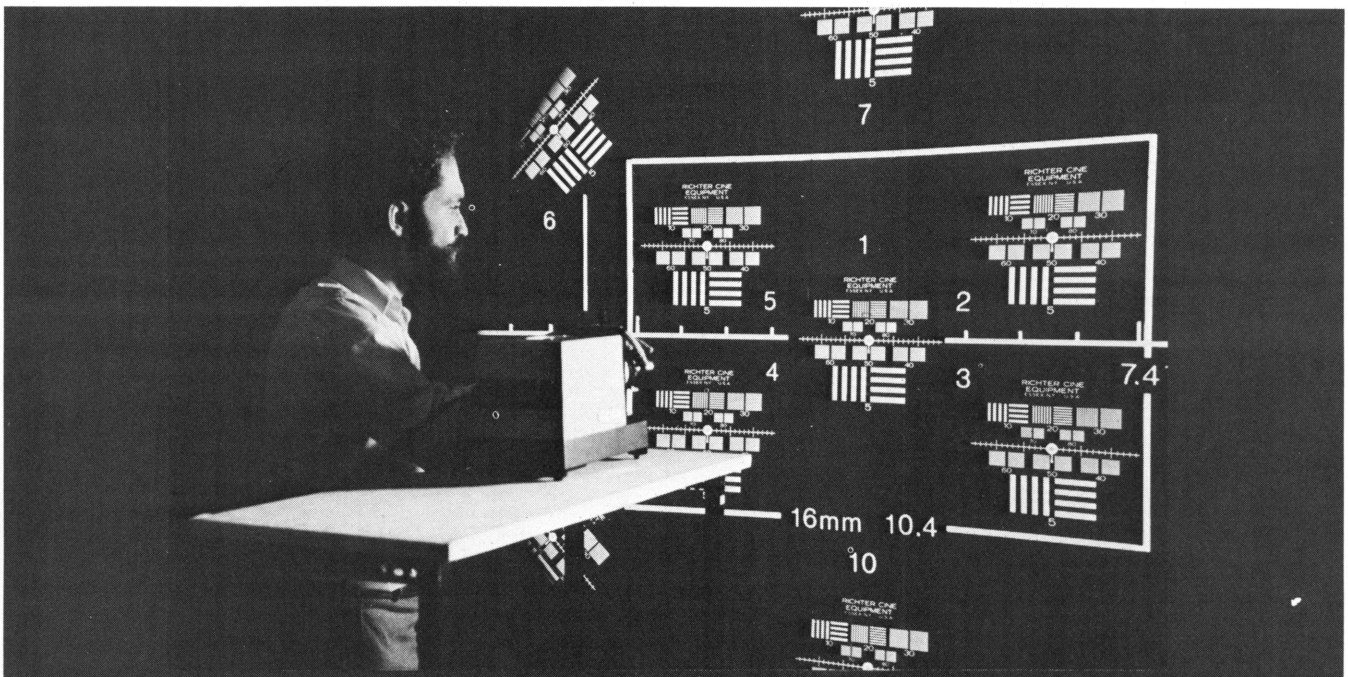

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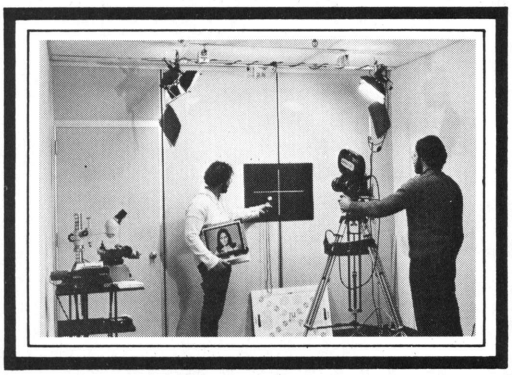

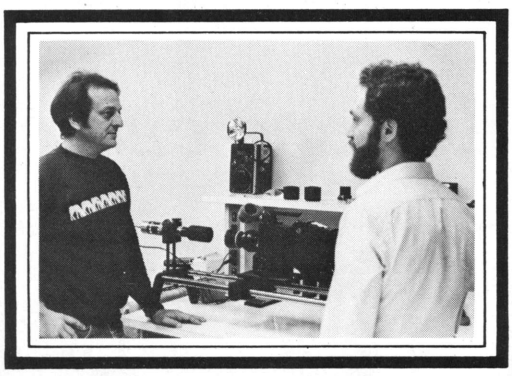

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VIDEO POST-PRODUCTION

Originally there was no such thing as "post-production" techniques in Video. Television was a "live medium, and there was no means of recording the images except by kinescopes. Now electronic technology and video production procedures have developed to the point where it is feasible to divide a production into distinct post-production phases over which it is possible to have as much control as one expects with film.

Perhaps the best way to become acquainted with electronic post-production techniques is to compare the electronic procedures with traditional procedures in film post-production step by step. We can start by eliminating negative processing. An electronic image is "processed" as it is shot and recorded. The closest thing in electronic cinematography to negative processing is probably the translation of the optical image into an electrical signal or the recording of this electrical signal on magnetic tape. Similarly the closest thing to forced development or "pushing" a film to increase its speed is boosting the gain on the camera control unit thereby amplifying the signal and increasing the sensitivity of the camera.

Instead of making a workprint, the electronic cinematographer has a ¾" dub made from his 1" or 2" original tapes. He may want to view the original and select takes to be transferred to ¾" and used for editing. Or he may simply transfer everything since it may be cheaper to do so. Sometimes a ¾" tape is recorded simultaneously during production, but it is generally considered advisable to transfer the ¾" from the original so that any defect on the original will show upon the ¾" used for editing. In some instances the working copies may be on ½" cassettes rather than ¾" cassettes, but the procedures are basically the same.

Time Code

Instead of key numbers and code numbers videotape uses time code, a series of numbers indicating hours, minutes, seconds and frames which are recorded by various methods either on a separate track area or on a portion of the video signal which is not used for picture information. The latter is referred to as vertical interval time code because it is recorded on the position of the signal corresponding to the time required for the scanning beam to return to the top of the frame to begin scanning the next series of lines. The use of vertical interval time code is a relatively recent development which was designed to overcome a limitation of time code recorded on a longitudinal track (generally channel 2 of the audio tracks on a ¾" cas-

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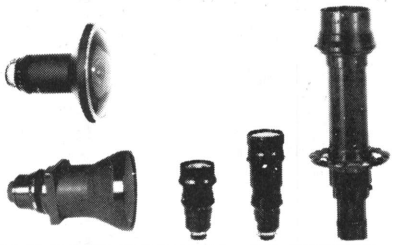

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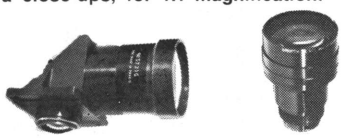

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sette). Longitudinal time code ceases to be legible when the playback machine is played too slowly or put into a hold frame mode. Vertical time code does not and has the further advantage of being transferable in the editing process so that the original coding always stays with picture information. Longitudinal time code cannot be transferred to another tape since the editing process requires continuous time code on the edited tape. With the proper equipment it is possible to edit using vertical time code alone, thereby freeing the second audio track for use in editing sound.

When time code is recorded on a 1" or 2" videotape, it can only be read by means of a time code reader which will then display the numbers on a screen or on a special digital device. When a ¾" dub is made for editing purposes, it is possible to display the time code in the picture signal for each frame. Such a copy is often referred to as a "window dub." Depending on the editing equipment used, window dubs can greatly facilitate the editing process, and the only reason not to burn the time code into the picture area is if the ¾" tape is intended for broadcast or for viewing under circumstances where the presence of the time code would constitute a significant distraction. Originally time code numbers in the frame were very large and covered perhaps 10% or 15% of the picture area. More recently it has become possible to make the time code numbering much smaller in the frame and considerably less bothersome while still being easily legible.

It should be noted that there are different standards in ¾" tape formats, and the time code is not always recorded in the same place on the tape by different machines. Sony, for example, has recently redesigned their ¾" format and added a special track for time code. In some instances time code recorded on one machine will not read properly on another, so it is advisable to verify the compatibility of the machines to be used when the ¾" cassettes are made for editing.

Also it should be noted that there are two kinds of SMPTE time code: "drop frame" and "non-drop frame." This is because the frame rate for NTSC video is not actually 30 frames per second but 29.970024. If the time code is to correspond exactly to the running time of the tape it is necessary to skip a frame number periodically. This is called "drop-frame" time code. Non-drop-frame time code is simply continuous time code. The difference is minimal, but if one is relying on the time code of an edited master to determine the precise duration time of the show, it is better to have drop-frame time code. Otherwise non-drop-frame time code will be over three seconds off at the end of a one hour show.

Production Sound Track

Since a production sound track is generally recorded on the same piece of tape with the picture information in a video production, the routine of synching the track to the picture is eliminated. There are, however, some circumstances under

(LEFT) The Vidtronics videocassette duplicating facility has over 2000 VHS and Beta dubbing machines and can produce over seven million cassettes a year. One advantage of videotape as a distribution medium is that numerous duplicates can be simultaneously made from one master. (RIGHT) The film-to-tape transfer facility at One Pass includes a Mark III Rank Cintel Flying Spot Scanner and a customized computer controlled scene-to-scene color correction system which allows primary colors to be corrected without affecting the other color components.

which double system sound is used with videotape, most notably musical productions in which a multi-track audio recording machine is used to record sound during videotaping. A multi-track tape is automatically synched to the videotape by means of SMPTE time code recorded on one of the channels, so there is still no need for the process of manually synching dailies. The only time a produciton sound track may have to be synched up with video tape manually is in a hybrid production shot on film and edited on tape. It is possible to transfer film to tape and then transfer the sound from the ¼″ original onto the videotape or a multi-track tape. In this case the clap stick on the track would be lined up with the clap stick being viewed on a monitor before locking the two machines together for transfer.

Off-Line Editing

The phase of videotape post-production which corresponds to the cutting of a film workprint is called "off-line" editing. "Off-line" as opposed to "on-line" refers to editing which does not involve the 1″ or 2″ master tapes, just as cutting a work print does not involve the negative. Off-line editing can be accomplished in a number of ways depending on the degree of sophistication in the facilities available. The crudest method is to do what is sometimes called a "paper edit." The ¾″ cassette is viewed on any monitor which is capable of holding on a single frame (actually a field); and as decisions are made for cuts, the time code for the frame is written down on a log sheet. The log is then taken to an on-line editing session and used as a guide for editing the 1″ or 2″ master. The only reason this is a feasible procedure is that a videotape is never physically cut and a cut (or "edit") can be tried any number of different ways in an on-line editing session. One can hardly instruct a film negative cutter to try a cut on several different frames to see which works best, but it is possible to do this in editing videotape originals. In many cases video productions skip over the off-line editing phase altogether. The only drawback to this approach is that on-line editing facilities and personnel cost upwards of $300 an hour and it can be very expensive to experiment in on-line editing. A "paper-edit" is a good way to cut the cost of the on-line editing while incurring minimal costs in off-line editing. It can even be done using a ½″ cassette on some Betamax or VHS format machines.

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The next step up in off-line editing uses what is called a "cuts only" off-line editing system. This is the procedure that is probably the most comparable to editing a film workprint. It requires two videocassette recorders, two monitors and a control unit which is capable of synching up the two cassette machines. One machine is used for playing back the dubs of the original tape and the other machine is used to record the selected scenes. The edited tape is built up scene by scene in continuity by dubbing over each cut in order onto the recording tape. All of the transitions appear as straight cuts just as they do in a film work print, and the time code numbers displayed in the picture area of the edited tape are the guide to repeating the editing process with the original tapes. Exactly how the editing is accomplished depends on the particular equipment used. A simple cuts-only system may have a "joystick" control which is used to line up the two machines on the point where the cut is to occur and a few buttons to push in order to "preview an edit" (i.e. see it on the monitor without actually recording it on the tape) or to "perform an edit" (actually record it) or to play back a cut that was just made. More complicated systems involve a keyboard and a data display monitor and enable the editor to make cuts in a variety of different ways. Some systems of this sort can produce fades on the edited tape, and some can be attached to a printer which will log all of the cuts on paper as they are made.

From here the next step up is a computer based off-line editing system using three or more videocassette machines and capable of doing dissolves, swipes, supers etc. Computer based systems store all the information about every cut and can be made to automatically re-execute every cut with changes which have been programmed in on the basis of viewing the previous version. They also produce an edit decision list which can enable the 1" or 2" master tapes to be automatically conformed to the edited ¾" cassettes—thereby reducing on-line editing time to an absolute minimum.

On-Line Editing

Once the off-line editing is completed, the master tapes are edited in an on-line session. If a computerized off-line system is used, the on-line editing may be a completely automated process. Most likely, however, there will still be some creative decisions to be made during an on-line session, particularly if there are special effects involved. Very few off-line editing facilities are likely to have access to all of

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the image processing equipment found in a sophisticated on-line editing bay, and it may not be feasible to automate every aspect of the on-line editing.

The end product of the on-line editing process is an edited master tape which is comparable to a cut negative. In order to see exactly how it relates to the cut negative, we should probably back up a bit. When a film editor locks the picture, he orders titles and opticals, and he spots music and effects. Before he can make an answer print, he must edit and mix the sound track, transfer it to a negative, and he must have scene-to-scene color corrections made for the negative. Essentially the same things can be done with videotape, but the procedures are different. First of all, editing of sound effects and non-sync music is generally done after the master tapes have been conformed to the edited tape. In a sense you cut your original before you spot music and effects. This is less hazardous than it might seem because with video tape the original can always be recut. Optical effects may have been viewed in the off-line editing if a computerized system is used, or they may simply be planned off-line and executed on-line. Virtually anything that can be done by an optical printer can be done electronically. Fades, dissolves, wipes,

The computerized audio mixing studio at One Pass Inc. of San Francisco used a 16 track recorder and unique computer program to facilitate synchronization and editing of sound for a video production.

freeze frames, step printing, frame blow-ups, or reductions, superimposition, travelling mattes etc. can all be previewed in a matter of minutes in any on-line editing session. Titles are generally matted in during the on-line session using title cards and a live camera or using a character generator which can set the type during the on-line session. Procedures used for "sweetening" a sound track are described elsewhere in this issue. Scene-to-scene color corrections are made as required

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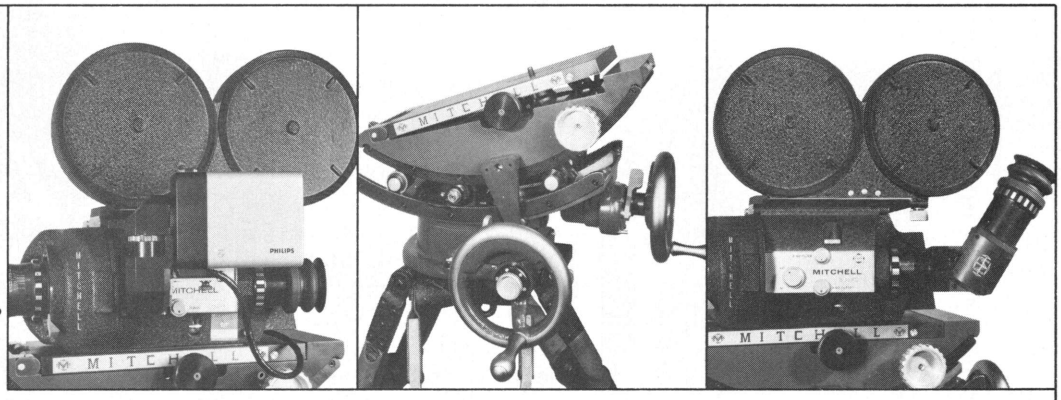

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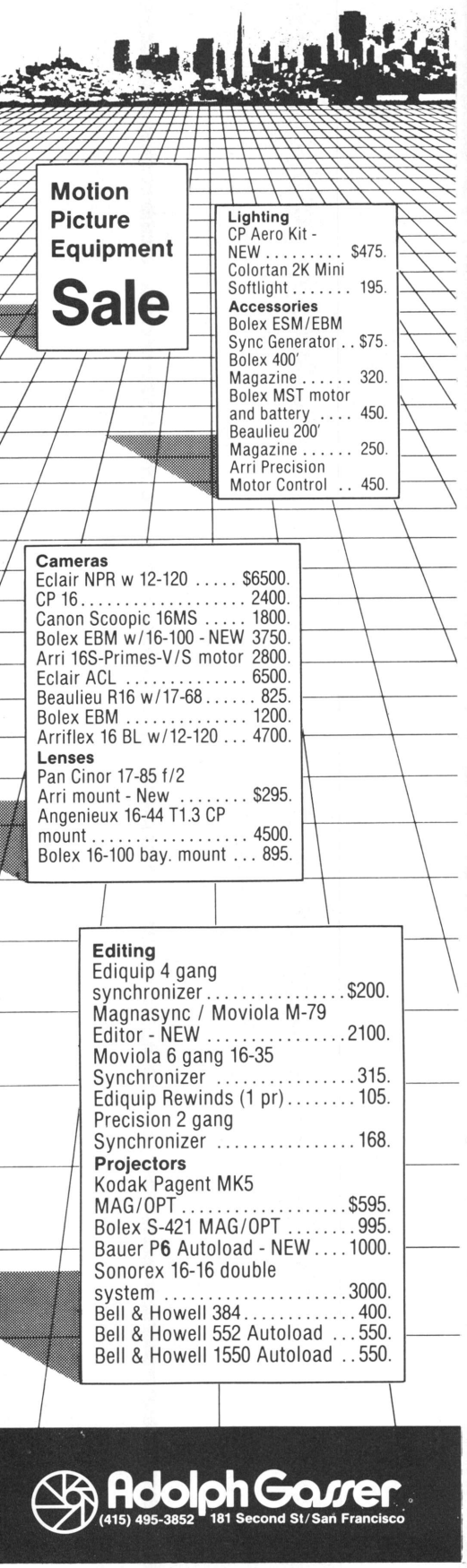
during on-line editing in much the same way a timer uses a Hazeltine for timing negatives.

An edited master can be used for broadcast or it can be used for making copies which are distributed. It is generally handled and stored with the same kind of care used in handling and storing a cut negative.

The greatest advantage that video post-production has over film post-production is the speed with which things can be done. A few of the procedures involved however take some getting used to, and a filmmaker who wanders into video post-production unprepared may find it to be a baffling and frustrating experience. First of all, the more complex a system is the greater the possibility that something can go wrong with it. Moreover, it is one thing to replace a broken drive belt on a Moviola and quite another to figure out how ambient static electricity is affecting the response of an electronic editing system. If an editor has been oversold on the speed of electronic image processing, he may find delays caused by mysterious technical problems a great deal more frustrating than the kind of delays he is accustomed to in lab work or film handling. Electronic processes may seem intangible and alien in comparison to a piece of film which can be held, viewed, marked and cut. Moreover the thought patterns and the procedures used in the electronic editing process may be very different from the way he goes about editing film.

Trims in Video Editing

The most striking example of this and the greatest single limitation of video editing is the question of how one deals with trims in editing video. A film editor may make it through his first assembly on videotape without any problem. When he decides he wants to trim six frames off a shot in the middle of a cut sequence, however, he has a problem he never faced with film. You can't just trim the frames and pull everything else up with a normal videotape editing system. Either you have to dub over everything before and after the cut onto a new tape or else you have to re-execute every cut before or after the one which was changed. In working with a cuts-only off-line system it is usually easiest to dub everything over to a new reel and alter the particular cut in the process. There is a limit, however, to the number of times a video signal on ¾" tape can be re-recorded before the image degradation becomes objectionable. Some people would say that four or five generations is the limit. This may or may not pose a problem depending on an editor's working method.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With a computer based off-line system it is possible to program in specific changes and then have the system automatically re-assemble the entire reel. In certain circumstances this can be almost as fast as dubbing over the entire reel, and it has two advantages. It preserves the image quality, and it simplifies the automatic logging of the edit decision last required for the on-line editing. A computer based editing system stores the time code information for every cut that is made. If an edited tape is dubbed over to another tape in order to make revisions, only the revisions are logged at that time; and the computer may not be able to read time code referring to the original source for the scenes. There is a program designed to track down original time code for every such revision after the editing process is completed, but it is a complex program which is not normally included in computer based editing systems.

Generally speaking, with a computerized off-line system the problems of trims and revisions is minimized by working initially with shorter sequences which can easily be re-assembled automatically and which are later assembled together to make a continuous tape for viewing.

There are two off-line editing systems currently available which were designed to overcome this limitation of electronic editing. One is a modification of a CMX editing system using a video disk, and the other is a system using two record machines running simultaneously. A video disk permits random access to the information stored on it, so that an editing system which records on a disk can enable scenes to be trimmed or rearranged instantaneously provided it is used properly. One Pass, Inc., a video facility in San Francisco, has a CMX 600 random access editing system with a disk which can hold up to 30 minutes of material in black and white. CMX themselves no longer manufacture this particular system because of its costs and its limitations. It is a fairly sure bet, however, that any number of manufacturers are developing video editing systems with random access storage.

The second off-line editing system which attempts to enable film style editing is a system developed by CBS using half-inch cassettes. This system, which will be described in detail in a future issue, essentially involves A and B roll recording on two machines whose sync with each other can be compensated to permit the lengthening or shortening of one scene without having to re-record others adjacent to it. ■

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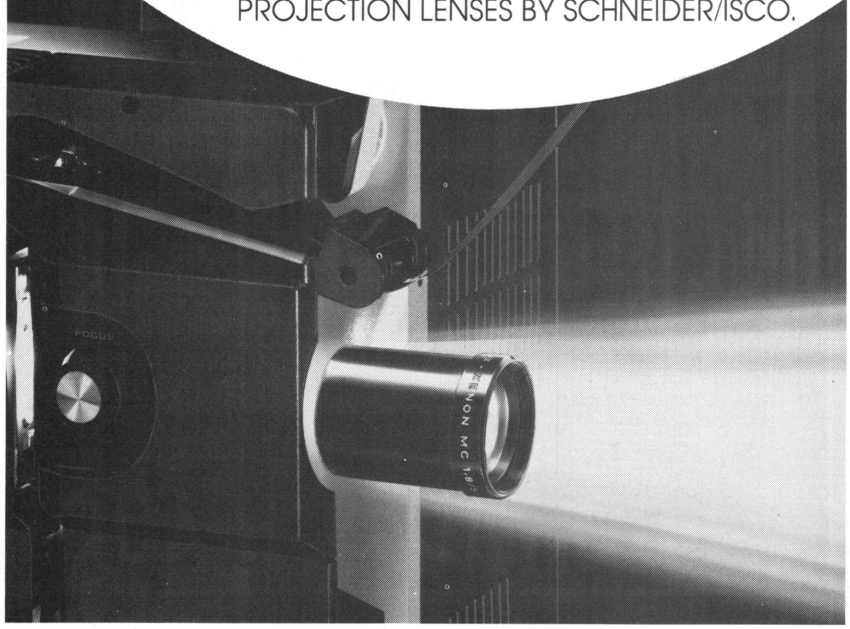

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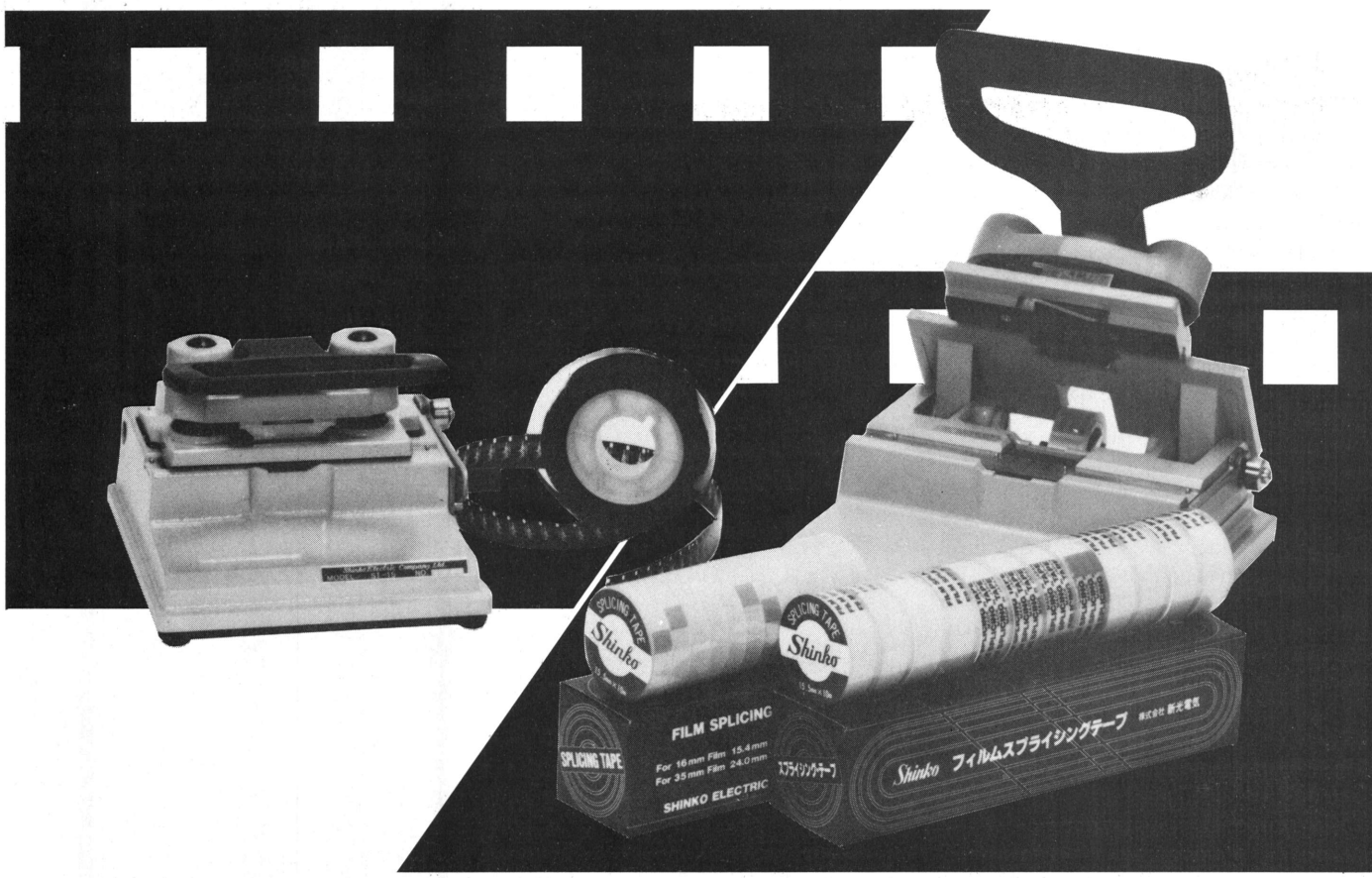

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A HMI and CID lamps are both in the metal halide family, both require a high voltage ignition and produce greater lumen-to-watt efficiency than quartz or incandescent lamps. The ballasts and igniters used for HMI can also be used for CID units. Both lamps are more expensive than quartz and a practical electronic dimming device is not yet available for general users at a reasonable price. Lamp life is similar for both lamp types.

HMI produces 80 to 120 lumens per watt, while CID produces 70 to 80 lumens per watt. HMI is considered less efficient as an optical source due to: 1) longer arc and 2) double ended contact characteristics. Claims have been made that the single coded CID lamp will be optically more efficient, due to its smaller arc, as well as a more rugged source since it is a smaller, single-ended lamp.

Manufacturers are introducing the CID units as either HMI or CID, which is to the users' benefit. In Europe, more CID units are in use than in the United States.

Until a separate unit for the CID lamp is available in the United States market, output comparisons are not readily available. Look for the new units at lighting manufacturer's booth at industry trade shows. The major advantage of the HMI units is their availability today.

Q I have recently seen a number of productions projected in the 1.85 format which appear to have little headroom. Are cinematographers composing pictures to fit both Academy and wide-screen aspect ratios or is this just a matter of the camera operator's preference?

A Some producers have decided that they want productions filmed in the 1.85 aspect ratio so that they can first show their product in the theaters as a wide-screen production and then on TV. In order to show on TV, they must have the full-frame aspect ratio. This means that all scenes must be framed for the full aperture, keeping out lights and microphones, etc., but the action must be confined to the 1.85 ratio. This is a difficult and unsatisfactory compromise, but it is the decision of the producer and not of the camera operator.

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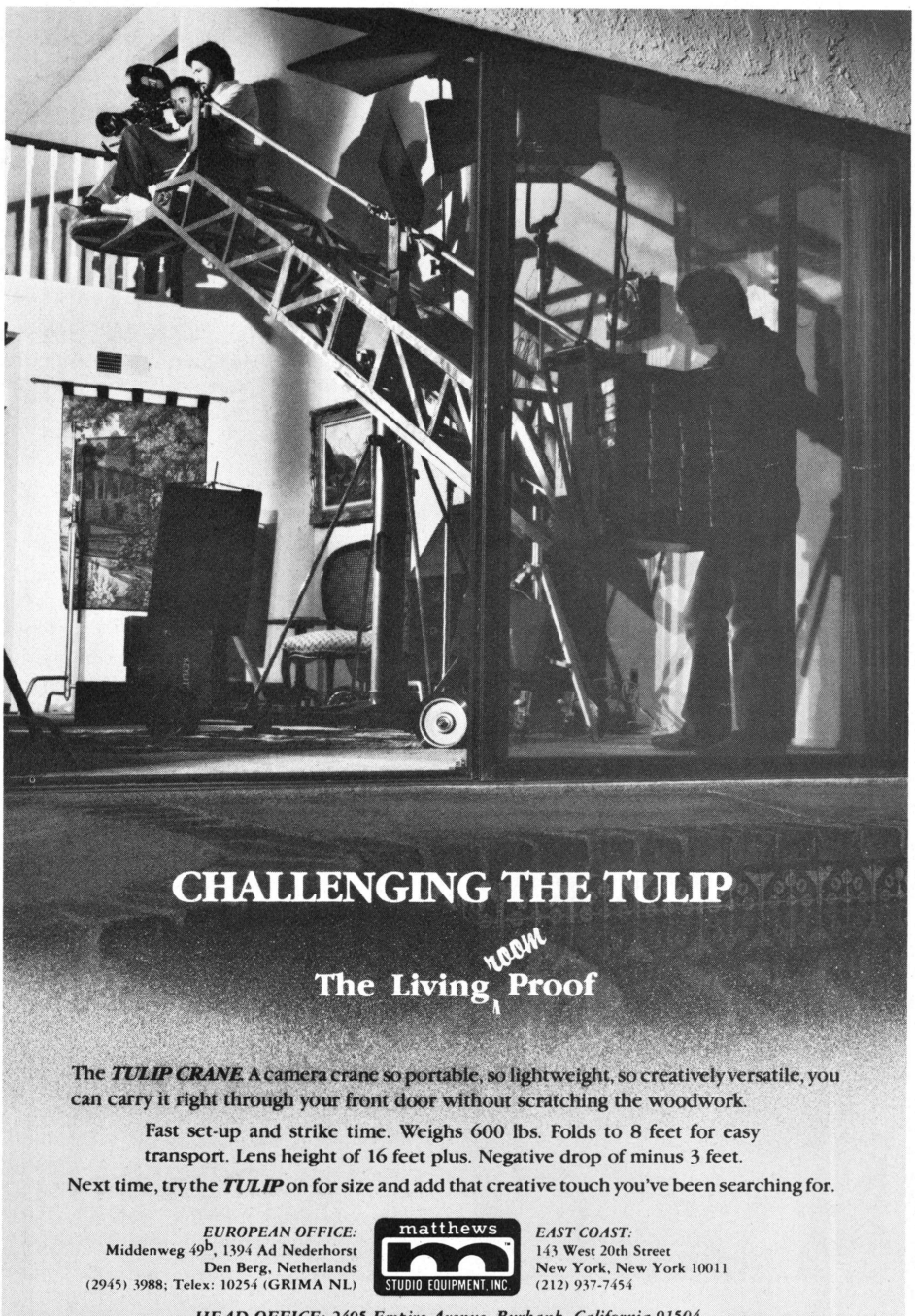
We encourage you to send us your questions on cinematography, as well as questions on the technical use of motion picture equipment. All inquiries will receive our prompt attention. ■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A.S.C. REMEMBERS GOLDWYN, SELZNICK AND ZANUCK AT GALA ANNUAL AFFAIR

Posthumous tributes were paid to three legendary producers, giants of the industry whose names are synonymous with great accomplishments, at the American Society of Cinematographers Gala Annual Affair, chaired by Stanley Cortez.

Daniel Selznick, Sam Goldwyn, Jr., and Richard Zanuck were honored guests of the A.S.C., accepting the awards on behalf of their fathers.

Daniel Selznick, who accepted the plaque for his father, said, "I feel very close to all of you, as I got to know my first cinematographer very well. My father engaged a studio cameraman to come to the hospital when I was born and then to come to the house every week of my first year and every year on my birthday thereafter until I was 18 years old."

Fay Kanin, screenwriter and president of the Academy of Motion Picture Arts and Sciences, accepted the award for Samuel Goldwyn, Jr. who was called out of town. In a statement which Mrs. Kanin read, Goldwyn expressed the feeling that his father's greatest dream for the future of the motion picture industry was that the crafts and guilds, such as the A.S.C., would constantly look for ways to bring young people with new ideas and fresh outlooks into our industry to give them the opportunity to grow, and to pass on to them the heritage of the great creators and craftsmen. "The knowledge that your society is recognizing this and doing something about it would make him very happy and it is in this spirit that the award is accepted on his behalf."

Daniel Selznick, Fay Kanin and Phil Dunne accepted plaques given posthumously to honor David O. Selznick, Samuel Goldwyn and Darryl F. Zanuck at the A.S.C. Annual Gala Affair.

Phil Dunne, writer, director and producer whose outstanding credits include HOW GREEN WAS MY VALLEY, 10 NORTH FREDERICK, PINKY, THE GHOST AND MRS. MUIR, among many others, accepted the plaque for Richard Zanuck who was also unexpectedly called out of town. Zanuck sent a telegram which read in part, "My father had a special affection for the art of cinematography and he often told me that he considered it, along with the written word, the most important function in filmmaking. I know he would be exceedingly proud of the recognition and the honor you have bestowed upon him, and I want to thank each and every one for this wonderful tribute."

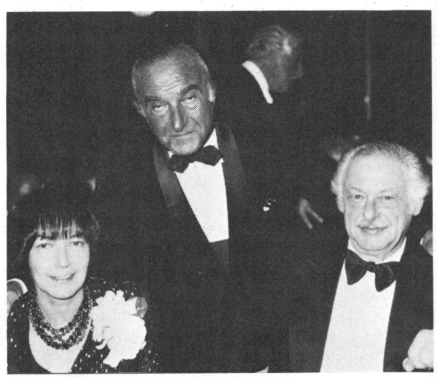
The inscription on the plaques read: The American Society of Cinematographers salutes *(David O. Selznick, Samuel Goldwyn, Darryl F. Zanuck).* "We applaud his wisdom and undaunted courage. We applaud his monumental achievements within the world of cinema. We applaud his indelible sympathy and creative relationship with the cinematographer. We applaud and salute his gifted talents bringing cultural enlightenment and joy to wherever people can see ... hear ... and feel."

Hal Kanter, writer, producer and humorist addressed the audience for the third year with wit and wisdom. "You have gathered this year to honor the life work and the evergreen memories of three men who made movie history and movie legends, Goldwyn, Zanuck and Selznick were not the least of those legends themselves," Kanter said. "These three knew the value of glamour. They invented it. As different as these three were, they had in common the qualities of tasteful judgment, imagination, dynamism and personal magnetism."

Kevin Thomas, assistant entertainment editor, movie reviews, for the Los Angeles Times was a special guest.

Thanks and appreciation of the A.S.C. are extended to Technicolor, DeLuxe, MGM Laboratories, CFI, Movielab, Photo Kem, Eastman Kodak, Rank, Photo Research, Howard Anderson Company, Hollywood Film Company, Cine Pro, Cinema Products, Mole-Richardson, Agfa-Gevaert, Inc. and the Society for the gifts which were given. ■

Fay Kanin, president of the Academy of Motion Picture Arts and Sciences, and Hal Kanter, writer and humorist are greeted by Stanley Cortez, chairman of the Gala event.



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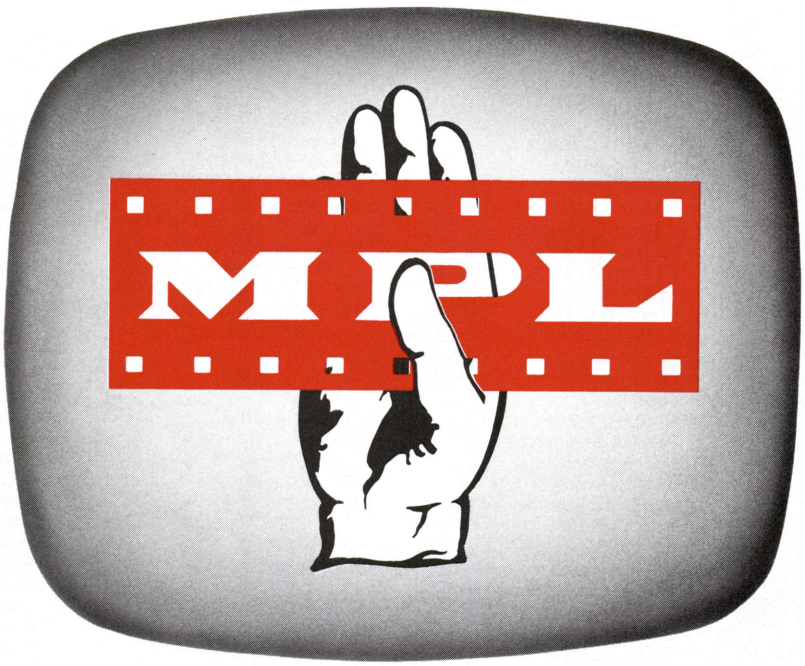

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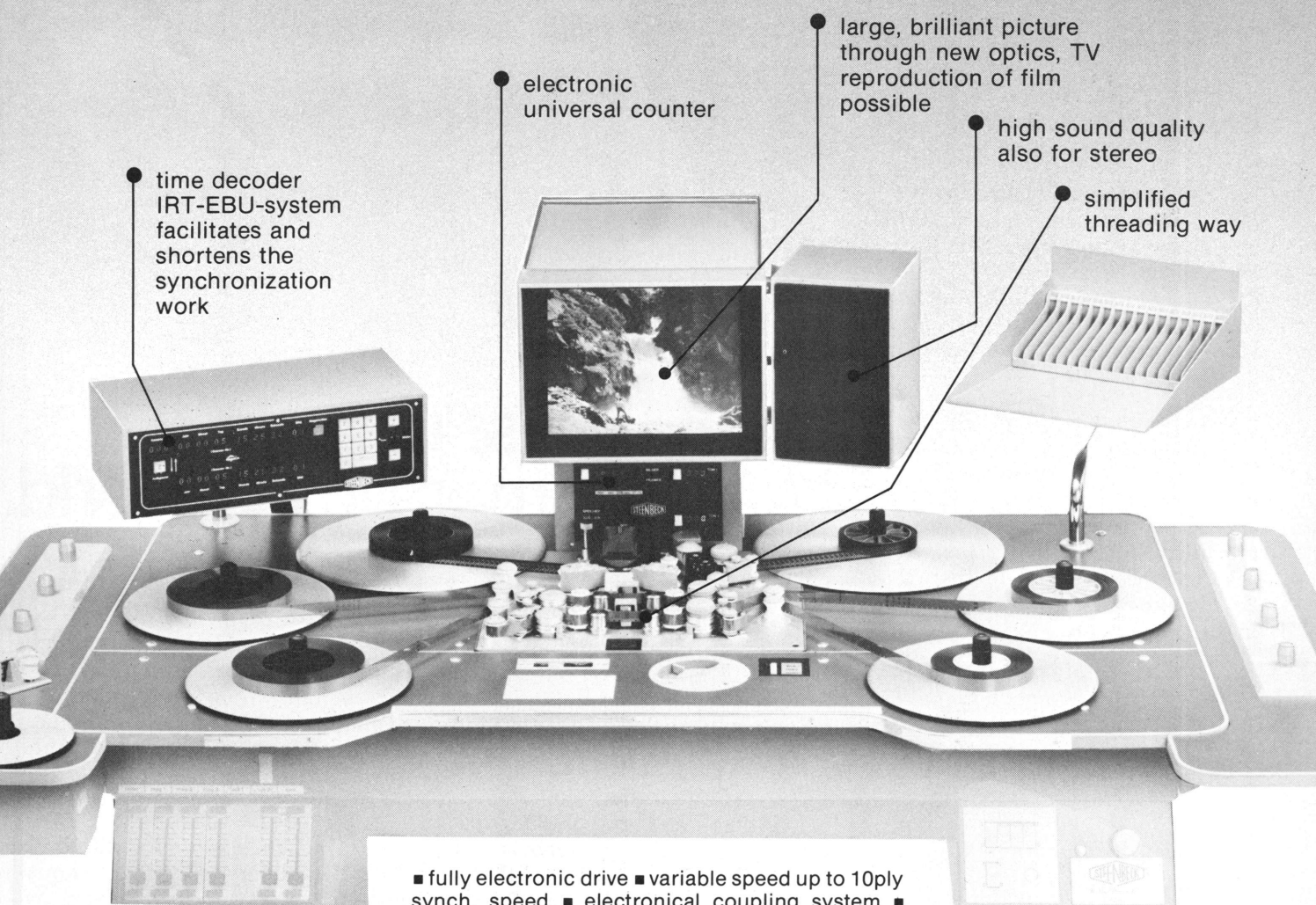
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VIDEO ASSISTED FILM EDITING

Three different systems for reducing film editing time by as much as 50% through the use of off-line video editing techniques.

Because of the speed and flexibility of computer based videotape editing, there is a great deal of interest in using video editing techniques for film production. If a filmmaker can shoot film, transfer it to tape, edit the tape and then conform the film to the edited tape; he may have the best of both worlds. Such a procedure is possible, but there is a basic problem involved in conforming film to an edited videotape which has only recently been solved. There are different approaches to solving the problem; and in order to appreciate what each solution has to offer, it may be helpful to review the nature of the problem.

Film runs at 24 frames per second and videotape runs at 30 frames per second (at least with NTSC standard equipment). Every "frame" of video is composed of two interwoven "fields" of scan lines so that it is possible to split a frame in half and still have picture information from top to bottom. In transferring to tape, the difference in the frame rate is compensated for by allocating three *fields* of video to every other frame of film instead of two fields. This is called a 3-2 pulldown. It produces a much more satisfactory transfer than would be achieved by simply repeating every fourth frame of film for a full frame of video, but it means that two out of every five video frames will consist of picture information from two different frames of film.

3-2 Pulldown

The effect of the 3-2 pulldown is never noticeable in viewing, but it creates a problem in conforming film to edited videotape transfers because most videotape editing equipment is designed to edit by frames and cannot detect a change in picture information that occurs in the middle of a video frame. If one attempts to correlate video time code to film counts, the time code identifying the video frame on which a cut occurs may correspond to two different film frames.

There are essentially three possible solutions to this problem:

1) Videotape equipment that operates at 24 frames per second

2) A coding system or an editing system which distinguishes between fields rather than frames

3) Computer programs which can correlate film counts from the film-to-tape transfer with conventional SMPTE time code.

Each of these solutions is feasible, and the latter two are already available commercially. In some ways video equipment operating at 24 frames per second seems to be the most attractive solution, and Consolidated Film Industries is currently developing just such a system. Compact Video has already developed 24 frame per second videotape recorders as part of their Image-Vision system for shooting on tape for transfer to film. There is a limitation with whis approach, however, in that the tapes used for editing would not be

Art Schneider of Consolidated Film Industries estimates that the Film V video assisted film editing system can cut editing time for a film production by 50%. The Film V system uses conventional SMPTE time code and requires no additional hardware in either the film-to-tape transfer stage or the off-line editing stage.

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"I've used TVC successfully for several years. I know I can depend on the people there. They care about my film."

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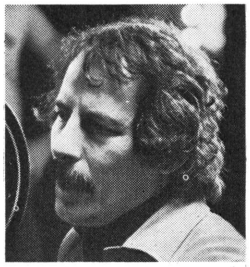

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Lou La Rose
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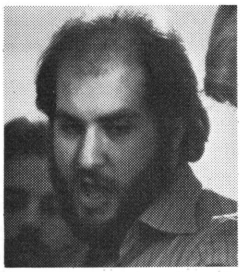
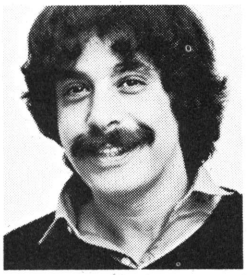
"100% of 'Maniac' was Chem-Toned. That saved us a ton of money."



Bill Lustig
Director/Producer "Maniac"



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Ira Wohl
Director "Best Boy"

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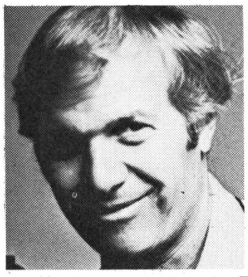

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Leo Lebowitz
Director/Cinematographer

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compatible with conventional video equipment, and it would not be feasible to use the tape transfers for anything other than off-line editing. They could presumably be converted to an NTSC standard using a computer based standards converter.

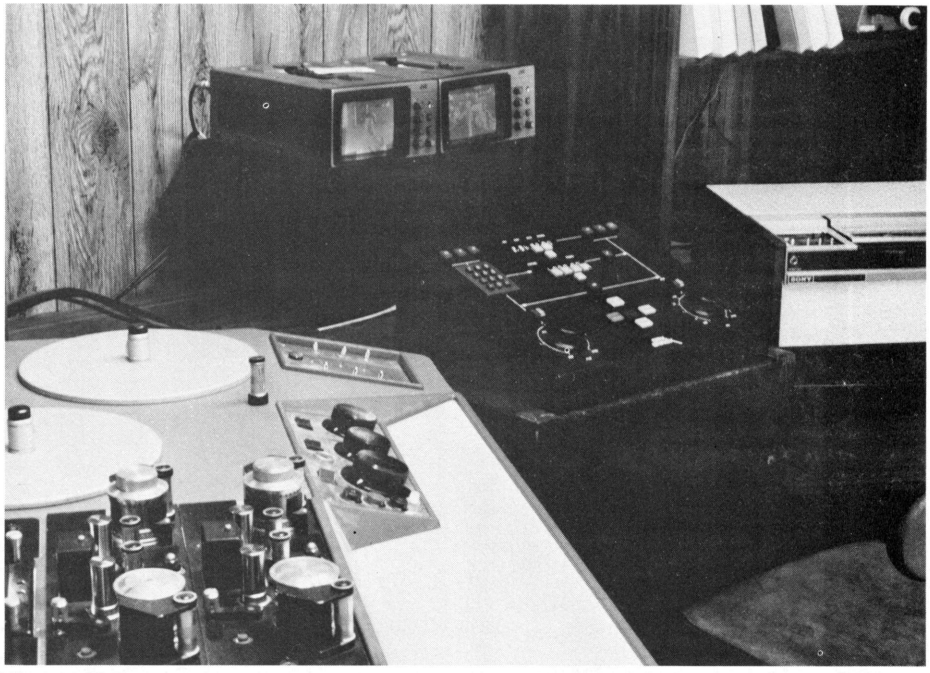
Gray Engineering Laboratories has developed a system for coding every field of videotape called Gray Field Code. Included with the video time code is a running record of film footage (in the form of key numbers) and frames as well as a record of the film reel number, the scene number, and the take number. The code is recorded on the tape in such a way that it can always be transferred along with the picture during the editing so that the final edited tape includes with it a record of the sources for every field of picture information. This information can then be printed out to provide a negative cutting log for the film which will specify precisely the film frame corresponding to the video field on which the cut occurs. The beginning and end of every scene would be logged in order with an indication of the reel, scene and take as well as the key number and frame.

When the film is originally transferred to tape, two pieces of equipment must be added to a conventional telecine operation in order to generate and record the Gray Field Code: A Frame Counter Multiplexer (Gray FCM-127) and a Data Transmitter (Gray DT-104F). If the code is to be displayed in the picture area as well, a third accessory must be added: A Vertical Interval Time Code Reader/Character Generator (Gray VCG-128). The code does not have to be displayed in the picture area for the system to work. If it is displayed, the final edited tape can be logged by simply viewing the tape on a monitor and writing down the numbers on the screen. This can be fairly time consuming, but it may be economically attractive in some circumstances.

Vertical Interval Time Code

The Gray Field Code is recorded onto the videotape in two different ways simultaneously. It is recorded longitudinally on one of the audio tracks just like conventional SMPTE time code and it is also recorded in the Vertical Interval Time Code format. Vertical Interval Time Code is an alternate way of recording time code which offers several advantages over a longitudinal track code. It is legible in slow motion or freeze frame modes of operation when the longitudinal track can no longer be read, and it can be transferred along with the picture information. A normal SMPTE time code cue track is not transferred during the editing process. The time code displayed in the picture area is recorded as part of the picture on the edited tape, but the actual cue track on the audio channel which can be read by the computer is not transferred to the edited tape because the recording tape needs to have its own continuous cue track. VITC does not use up audio channel and can be replaced. Vertical Interval Time Code can be transferred regardless of whether it is displayed in the picture area and does not interfere with the continuous cue track on the record tape. As a result Vertical Interval Time Code enables an editor to go through several generations of edited tapes without leaving behind the data indicating the original source for the picture in every scene.

Use of vertical interval time code can also free the second audio channel on which the longitudinal time code is recorded for use in editing the sound track – provided the editing equipment does not need longitudinal code in some modes of operation. With some equipment vertical interval time code can be read at up to 40 times speed eliminating the need for longitudinal code in the search or shuttle mode. It is possible also to replace vertical interval time code without disturbing the picture information.



The CMX FLM-I can be used to interlock a flatbed film transport and a videocassette recorder. The control console is about the size of a briefcase and has variable speed control knobs similar to ones found on some flatbed film editing machines.

The Gray Field Code can be longitudinal during the film-to-tape transfer just like regular time code in order to facilitate high speed searching on playback machines not equipped to read vertical interval code at high speeds.

The principal advantages of the Gray Field Code system for video assisted film editing is that the off-line video editing can be done on any kind of frame accurate cuts-only video editing system such as a Convergence ECS-90. Because the time code and film source data are always transferred with the image, there is no need for a computer based editing system which maintains a running log of all cuts. The Gray system is compatible with full blown computerized editing systems as well, and Harris Video has adapted their Epic editing system to use Gray Field Code.

Manual Logging

When a simple cuts-only editing system is used, the logging of the cuts can be done in three ways. If the code is displayed in the picture area, the edited tape can be played back and the numbers logged manually as the tape is stopped before and after each cut. If the code is not displayed in the picture area, it can still be manually logged with the help of a Vertical Interval Time Code Reader/Character Generator which would cause the code to be displayed. Finally the logging can be done automatically with the help of a log-

```
          PRODUCTION:  SATURDAY SPORTS
          SEQUENCE:  JUNIOR RACING
          DATE: 5/8/81
          REVISION: 1
          PRODUCER:  JOHNSON
          EDITOR: SMITH
          OPERATOR:  O'CONNOR
          MASTER FILM FORMAT:   FRAMES/FOOT  :16          FRAMES/SECOND  :24
..................................... VIDEO FEDL .....................................

EDT  RL#  SCN  TK  EDIT IN   EDIT OUT  MSTR IN   MSTR OUT  DURATION  EFX  DUR  KSR  PTN  PS

RACE CAR SEQUENCE PRESENTER
001  025  003  01  11649.09  11663.09  00000.00  00014.00  00014.00  C

OPENING SHOT OF THE TRACK
002  013  005  01  07052.08  07060.12  00014.00  00022.04  00008.04  W    024       002   75

WIPES TO CORNER BOX WITH PRESENTER
003  025  012  02  11717.15  11728.05  00022.04  00032.10  00010.06  C
004  013  022  01  07103.04  07116.05  00032.10  00045.11  00013.01  C

MCU OF THE FIRST TURN
005  026  008  02  11757.08  11768.15  00045.11  00057.02  00011.07  C

VO CONTESTANTS
006  013  027  01  07186.15  07203.10  00057.02  00073.13  00016.11
007  026  009  01  11633.05  11640.04  00073.13  00090.12  00006.15  D    024  CGN

BRING UP SUPER
008  026  009  01  11640.04  11647.12  00090.12  00098.04  00007.08  D    024

TAKE IT OUT
009  026  009  01  11647.12  11659.12  00098.04  00110.04  00012.00  C
```

The film cut list from a Harris EPIC editing system modified to use Gray Field Code specifies the key number and frame of film corresponding to the video frame at which the cut has been made. Such a list contains all the information required to conform the negative precisely to the edited videotape.

ging device such as a Gray EDL-130 Edit Decision Logger, which reads the vertical interval time code and prints out a log of all the cuts.

One thing should be noted in connection with manual logging of the cuts. The Gray Field Code is such that the reel, scene and take numbers are not all included on each field but are spread out sequentially over six frames. In logging each cut manually it is necessary to back up or go forward six frames from the actual cut in order to log all the information. A recently proposed standard for encoding information on videotape would make it possible to include all of the reel, scene and take numbers on 2 frames instead.

Automatic Logging

Using an edit decision logger greatly expedites this process since it is capable of logging the cuts in real time. A one hour show takes one hour to log. A list is printed out which would enable a negative cutter to cut the negative to conform to the edited tape.

Another method of automatically logging a tape edited on a cuts-only system is to use a computer editing system for logging instead of an Edit Decision Logger. Simply playing back the edited tape on a computer editing system and disconnecting the normal cue track from the playback machine will cause the computer to read the vertical interval time code. The system can then print out the same edit list as an edit decision logger would do.

If the editing is to be done on a computer editing system, the system must be augmented by a Vertical Interval Decoder (Gray VID-125) for each playback machine. The decoders will automatically read the longitudinal cue track time code at higher speeds and the vertical interval time code at slower speeds. The editing system must be capable of reading and processing Gray Field Code rather than just a conventional frame rate SMPTE code; but if it is, the Gray Field Code will function for the system in the same way the SMPTE code does. It may even enable the system to perform cuts on fields rather than frames.

Since a computer based editing system is capable of transitional effects in which two images are combined, it is necessary for the system to be able to choose between two vertical interval time codes and encode the appropriate one onto the edited tape. This is accomplished by adding a Data Selector Inserter (Gray DSI-126) to the system. When a dissolve or wipe is programmed, the Data Selector Insertor automatically encodes the vertical interval time code for the outgoing scene onto the edited tape up to the midpoint of the transition and then switches over to the code from the incoming scene for the last half of the transition. This is designed to match the way a film workprint is cut for an optical transition.

A computer editing system automatically logs every cut as it is made

so that a direct print-out could be u
as a guide for cutting the negat
However such a log would include
the cuts made during the editing p
cess and not just the ones in the f
version. For this reason it would be
ter to re-log the final edited versio
putting it on the playback deck
causing the system to read the vert
interval time code only.

Precise Running Time

The Gray Field Code system res
in a film cutting log which speci
precisely the film frame that co
sponds to the video frame (or field
which the cut was made in editing
tape. However, if a simple cut-only s
tem is used for editing the videota
the actual running time of the edi
film may vary slightly from the runn
time for the edited tape. This is beca
of the 3-2 pulldown in the original f
to-tape transfer. Unless a compu
is analyzing all of the code infor
tion, there is no way to be certain t
every cut on the videotape will have
appropriate balance between 3-fi
and 2-field film frames.

For example to take the most
treme possible case, suppose t
every scene in the edited show h
pened to have an odd number of f
frames and that the first film frame
each scene happened to be one t
was transferred to three fields of vi
rather than two. This would mean t
for each scene after the first cut,
would be accumulating one extra vi
field than the tape should have in or
to correspond exactly to the runn
time of the film. If the show had
such cuts, the edited videotape wo
be two seconds longer than the c
formed film.

Since the system is essenti
designed as an assist for film editi
this does not create an insurmounta
problem. Sync with the track can
maintained by cutting the magne
track in the same way as the film
other words if the original film tra
fers are made in interlock with a m
track which is coded to match the fi
then an edit list from the system
enable the mag track to be conform
If precise running time is critical for a
reason, it may be necessary to ma
an adjustment in the film and the m
track after they have been conforme

Another way to handle the sou
track would be to retransfer the c
formed film to video tape and make a
adjustments required on the sou
track using multi-track sweeten
techniques normally used for vid

This would require that the sound track be transferred to multi-track tape along with the field code when the film-to-tape transfers are made, but it would enable the first phase of the sound editing to be done automatically by a computer based editing system. Then if there is a discrepancy in the total running time between the edited multi-track tape and the conformed film, it would be necessary to make adjustments in the multi-track tape.

A computer can eliminate any potential discrepancy between the running time of the edited tape and the conformed film by keeping track of the balance between 3-field and 2-field film frames and compensating automatically during the editing process. Since Gray Field Code includes film footage and frame information for every field of video, it is possible for the computer to know whenever a running time discrepancy would occur, and it can automatically adjust the length of a scene as necessary. This is not a normal program in a computer based video editing system, but it can be added to one. Harris has developed such a "film mode" modification for their EPIC editing system. It involves one minor hardware modification and a program available on a floppy disk.

CFI Film System

The potential discrepancy between the running time of the tape and the conformed film is eliminated in a different manner with another video assisted film editing system developed by Consolidated Film Industries. In addition to developing 24 frame per second video equipment, C.F.I. has developed a video assisted film editing system designed to be compatible with current NTSC standard equipment. The approach taken by C.F.I. in designing this system differs from the Gray system in three basic ways. The CFI system, called Film V is designed primarily for use with computer editing systems, it does not require any additional hardware for the telecine or the off-line editing operations, and it does not rely on vertical interval time code. It is essentially a procedure for transferring film to tape and a computer program which corelates the conventional SMPTE time code edit list for the edited tape to film counts derived from the transfer procedure.

Because C.F.I. is a full service laboratory with both film and videotape facilities, it was in a unique position to develop this kind of video assisted film editing system. It is a proprietary system which is unique to C.F.I., but it represents a basic approach which could also be taken by other facilities having similar resources. Since it is perhaps the most complete service currently available, it may be useful to outline the procedures involved step by step.

Logging and Transferring

The first step in the process is to log the film, clean it and transfer it to tape. C.F.I. uses a Rank Cintel Flying Spot Scanner and can transfer directly from negative. Although some producers are apprehensive about transferring from negative rather than a print, it is possible to achieve better image quality with negative, and C.F.I. has never had a problem with damage to negatives using a Rank Cintel. The worst that has happened is static dust on the negative which can be easily removed by sonic cleaning. The Rank Cintel has a continuous rather than an intermittent movement so the negative is subjected to less strain than it would be in some printers. The negative image is converted to a positive image electronically before it is recorded onto the videotape, and using negative rather than a print results in greater sharp-

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```
EVN  REEL/SCN FILM RLN    CUT-IN            CUT-OUT           DURATION    TYPE

THE NEXT EDIT IS PART OF AN OPTICAL EFFECT
001 32A-4     828      F23X46846 +01    F23X46856 +09        00010+07 DISSOLVE

002 33-1      829      F19X49247 +10    F19X49252 +02        00004+07    CUT

003 32A-5     828      F12X33334 +09    F12X33343 +03        00008+09    CUT

004 34B-2     830      F11X54959 +07    F11X54968 +07        00008+15    CUT

005 32A-5     828      F12X33337 +07    F12X33346 +07        00008+15    CUT

EDITS USING FILM REEL#828

EVN  REEL/SCN FILM RLN    CUT-IN            CUT-OUT           DURATION    TYPE

THE NEXT EDIT IS PART OF AN OPTICAL EFFECT
001 32A-4     828      F23X46846 +01    F23X46856 +09        00010+07 DISSOLVE

THE NEXT EDIT IS PART OF AN OPTICAL EFFECT
007 32A-4     828      F23X45413 +08    F23X45437 +01        00023+09    CUT

012 32A-4     828      F23X46314 +01    F23X46324 +08        00010+07    CUT

LIST OF ALL MATERIALS TO BE DUPLICATED

EVENT 003 AND EVENT 005 OVERLAP

EVN  REEL/SCN FILM RLN    CUT-IN            CUT-OUT           DURATION    TYPE
005 32A-5     828      F12X33337 +07    F12X33346 +07        00009+01    CUT


014 32A-4     828      F23X46269 +09    F23X46276 +10        00007+01    CUT

SPECIAL EFFECTS LIST
NO.  START PRINTING     START OUT      FULL IN       STOP PRINTING  LENGTH      EFFI

008  F23X45413 +08   F23X45437 +01   F19X46422 +14   F19X46500 +01 00002+04   DISSI

017  F11X55184 +07   F11X55278 +15   BL  00001 +07   BL  00004 +06 00001+08   FADE
```

The Film V system at CFI prints out several different lists. Shown above are excerpts from 1) a list of every cut taken in the program in continuity, 2) a list of every cut taken from each reel of film, 3) a list of every scene which must be duplicated or used in an optical and 4) an optical count sheet for every special effect.

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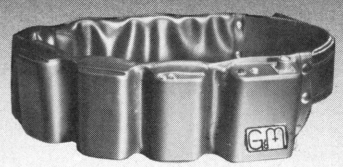

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ness and better color rendition. It also eliminates the cost of making a workprint. If the show is destinied for initial release on videotape, cleaning of the negative prior to transfer becomes critical since dirt on a negative will show up as white spots on the positive image. If for any reason a producer prefers to make a print and transfer from the print rather than the negative, he can do so; but CFI would normally recommend transferring from the negative.

Before transferring, it is necessary to log the negative and to mark a reference frame for each roll or section of negative. The negative assembler logs the key number and frame for each slate sync point so that later on the SMPTE time code numbers can be logged and correlated with the key numbers. It is sometimes simpler to edge code the assembled negative so that each roll of negative can have a continuous series of numbers and a transfer of the sound track can be coded to conform to the negative. Although some producers might hesitate to code camera original, C.F.I. has had no more problems with damage to film in coding than with any other laboratory procedure involving camera original.

Sync Sound

Sync sound can be handled in two ways. The simplest is probably to transfer the film to tape silent and then sync the sound up with the ¾" videocassette transferring it directly from the ¼" original to a multi-track tape along with the time code from the videotape. A work track is also transferred onto the videocassette. The other is to make a 16mm or 35mm transfer of the sound, sync it up to the film and transfer in interlock. If a show is intended primarily for film release, the transfer is made only to ¾" videocassette. In this case a multi-track transfer of the track is made simultaneously when transferring in interlock. If a show is intended for initial release on tape followed by a subsequent release on film, the film-to-tape transfer is done on 1" or 2" videotape as well as the ¾" videocassette, and there is no need for a multi-track transfer of the sound since the sound quality of the 1" or 2" videotape is good enough.

Although the film-to-tape transfers can be made on any telecine comparable to the Rank Cintel used by C.F.I., and it is not absolutely necessary to make the transfers at C.F.I.; there are certain procedures which must be followed in making the transfers in order

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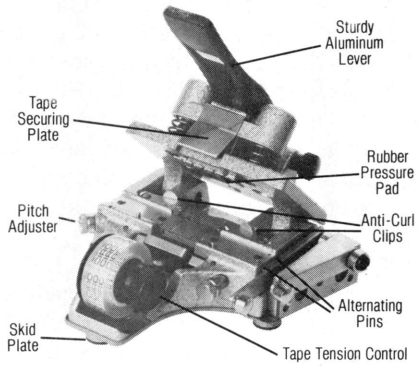

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for the system to work. It is essential to consult with C.F.I. before making the film-to-tape transfers if one plans to use the Film V system for conforming film to an edited videotape.

Editing

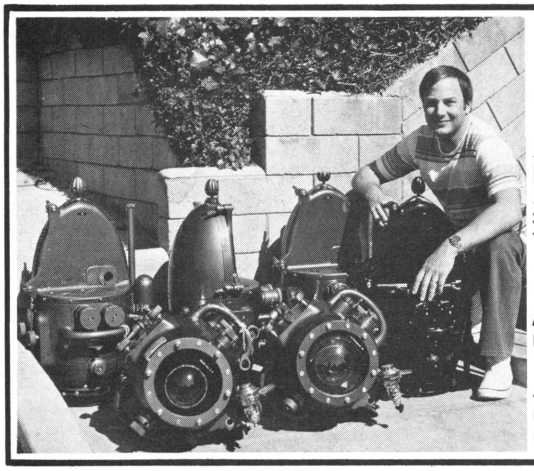
Editing of the show is done using the ¾" tapes just like any off-line videotape editing. Film V is designed primarily for use with computer based off-line editing systems and is compatible with any system which will generate an edit decision list compatible with a CMX or Mach I editing system. If a simpler cuts-only off-line system is used for editing, it is possible to manually log the time code displayed in the picture area of the edited tape and enter the log into the computer via a keyboard. It is essential to have the time code displayed in the picture area if a simple cuts-only system is to be used, and it is advisable to display the time code in the picture area no matter what kind of editing system is being used.

Some computerized editing systems automatically log all the cuts as they are made. If the editing process involved re-recording an edited tape or going through several generations to arrive at the final cut, there is a program which can track down the time codes indicating the original source for each scene in the final cut. (The SMPTE time code associated with a particular scene changes each time the scene is dubbed over from one cassette to another in the editing process, but the editing system stores all the information associated with each such transfer and it can be retrieved.) The edit decision list which reflects the original SMPTE time code for each scene in the final cut is then fed into the Film V system. The system correlates it to the film counts and produces a breakdown of all the information necessary to make the opticals and cut the negative.

Lists From Film V

There is a list of every scene in each reel in order of continuity. Each scene is identified by slate number and take number and there is an indication of the film roll from which the scene came. The exact frame for the beginning and end of each cut and the duration of the scene is specified in film footage and frames.

The list also specifies whether each transition is a straight cut or an effect. If it is an effect such as a fade or dissolve or wipe, the length of the effect is specified. There is also a separate special effects list which is in the same



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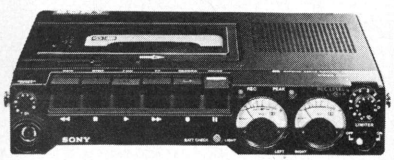

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format as an optical count sheet and provides all the information necessary to execute the opticals.

In addition there is a list of all the materials which need to be duplicated in order to shoot the opticals or cut the negative. If the editor for any reason used the same footage twice in cutting the show, the footage would show up on the list to be duplicated. (One thing a film editor using a video assist should be aware of is that there is no immediate indication when a shot or a particular portion of a shot has already been used in the editing. A video assembly is made by duplicating images rather than physically removing them from a roll so that it is possible in video editing to use the same frames any number of times without having to go an extra generation.)

Once the film cutting log has been printed out by the computer, it is possible to turn the negative over to the negative cutter and have it cut to conform to the edited videotape. Some negative cutters may balk at the notion of cutting negative simply from a log sheet without a workprint to use as a visual guide, but negative cutters at C.F.I. have done this successfully. There is room for human error in reading the numbers of course, and it may be advisable to make an inexpensive black and white kinescope from the edited tape to run through the synchronizer as a guide in cutting the negative.

The sound track is edited automatically by the edit list from the off-line system, sweetened and transferred to an optical track negative which is assembled with the cut picture negative for printing.

The Film V system at C.F.I. has been used successfully on television episodes shot on film, and one comparison test indicated that it can reduce the amount of time required for editing by 50%.

CMX FLM-I System

A third approach to video assisted film editing has been developed by CMX/ORROX makers of the CMX computer editing system. Their approach has been to design a system with which film editors will feel comfortable and which offers a film production some of the advantages of videotape editing without the cost of a fully computerized system. It does not involve transferring all of the film to videotape, but adapts a flatbed film editing table so that it can run in constant sync with a ¾" videotape recorder. Rather than viewing the image via an optical sys-

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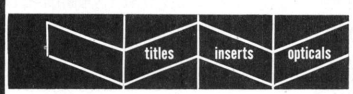

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tem, it converts the film image into an electronic image which can be viewed on a monitor and recorded on the videocassette recorder. (The same system can be used to sync up a Rank Cintel telecine with a 1" or 2" VTR for "on-line" editing from film original, but here we shall focus on its use with a flatbed editor and a ¾" cassette recorder.) Instead of cutting and splicing the workprint for a first cut, the editing is done by assembling the first cut on ¾" tape. The editor will select a scene, find his start and stop points and record it on the tape. He can preview cuts without actually recording until he finds the one he likes best, and then record it or "perform the edit" as video editors are wont to say. In this manner he can assemble a first cut on videotape, show it to people and make changes in it without ever cutting a frame of film. The system includes a printer which logs every cut as it is made, giving the precise film footage and frame at which the cut was made. This list can be used for cutting the film and track after the videotape version is approved.

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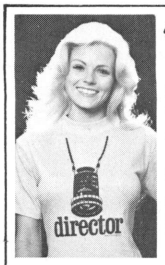
On the CMX cut list P means picture, and A1 and A2 refer to the two audio channels.

No 3-2 Pull Down

Because this system does not involve a normal telecine there is no 3-2 pull down. The difference in the frame rates for the film and the tape is compensated for by transferring each film frame to 2½ *fields* of video and programming the system not to permit cuts on the fields which are split between two frames. The video field is split by continuing to scan the film image as the frame changes, so that the field has half of one frame on the top and half of the next frame on the bottom (just like the image on a flatbed screen when the film is stopped



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between two frames). The system is designed to stop only at a particular point relative to the position of the film frameline in the flatbed. When it is asked to make a cut at a frameline corresponding to the middle of a video field, the system automatically backs up or moves forward to the beginning of a video field. The direction in which it will move depends on the direction it moved the last time it compensated. In essence it remembers whether it owes you a half a frame of video in order to maintain dead sync. All that is required to keep track of this is a simple on/off circuit, and the greatest potential discrepancy between the running time of the conformed film and the running time of the videotape is half a video field or 1/120th of a second.

Working Methods

The CMX FLM-I system is not designed to replace completely the editing of a film workprint. It is designed to reduce the handling of the film and the time required to experiment with various versions of a sequence. It works best with shorter sequences rather than an entire show, and can be an extremely valuable tool when used properly. The limitations of the system must be understood however. Unless it is connected to an auxiliary floppy disk unit, it will not store all the information about every cut that has been made. By itself it stores two "events" at a time, printing out the earlier one in order to make room for a new one. What this means is that it will give the editor a complete record of how he cut any sequence, but he cannot re-edit the sequence by dubbing portions of it over to a new reel and re-editing the other sections from the film. If he does this, his edit decision list for the new version will not include all of the cuts that were not re-executed using the film. Depending on the particular editing job, the amount of paper work required to track sources of material manually might defeat the purpose of the system.

What the editor can do, however, is cut any number of versions of the same sequence to be viewed at the same time, and he can experiment to his heart's content as he goes through assembling a sequence. Rather than try to envision a cut in his head before he decides where actually to splice the film, he can try it several different ways on the tape first. Since the system has a preview mode, he can transfer a long tail trim for a scene and then try the cut to the next scene in a variety of ways

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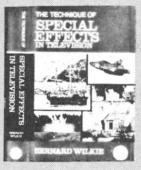

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before recording the cut onto the videotape and erasing the tail trim of the outgoing scene. Editors who are accustomed to working on a Moviola rather than a flatbed may find this a particularly appealing working method. In some instances the system may enable an editor to arrive at a final cut and provide a log for the negative cutter without ever cutting his workprint. He may also choose to conform his workprint to the log first before cutting the negative, or he may conform the workprint to a first cut and use the system to facilitate re-cuts. The system may be especially useful in editing commercials or other short subjects. It is estimated that the system can reduce film editing time by as much as 30% or 40% simply by eliminating so much of the physical work.

Economy and Flexibility

Perhaps the greatest advantage of the system relative to the other video assisted film editing systems is its cost. The cost of the hardware and the modifications to a flatbed are low enough to make it feasible for a production company to do video assisted film editing in-house. The other advantage is that it does not confront the film editor with a completely alien machine or working method. The controls for the system are very similar to controls for a normal flatbed editing table except that instead of marking the film with a grease pencil, the editor pushes a button on the console.

The CMX film editing system can also be used in a variety of other ways. It can be used to cut conventional film sound tracks on the flatbed for a video production, for example. A ¾" dub of the edited videotape is run on the videotape recorder in sync with tracks being edited on the flatbed. More than one flatbed can be slaved to the system, and it could be used for mixing in sync with a ¾" videocassette as well. The system can also be synchronized with a telecine rather than a flatbed editing machine. In this case it could be used to create edited broadcast quality videotape directly from film original without cutting the original. ■

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SITUATIONS AVAILABLE

FACULTY TENURE-TRACK. Teach 16mm film production, all phases. Professional production and/or academic background desired. For information, write Search Committee, Film Department, San Francisco State University, 1600 Holloway, San Francisco, CA 94132. SFSU is an AA/EO employer.

HELP WANTED TECHNICAL PERSONNEL
IDI has openings in Miami and Atlanta for camera/optical, electronic technicians, rental sales personnel, super secretaries. 16/35mm or video experience ESSENTIAL. Very interesting growth potential for career-oriented, energetic nonsmoker. Resume to IMAGE DEVICES, 1825 NE 149 St., Miami, FL 33181.

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TWO TELECOMMUNICATIONS/FILM teaching positions in rank of assistant or associate professor (dependent on qualifications and experience). Candidate should have teaching or professional experience in one or more of the following fields: (1) film production, (2) writing for film and television, (3) television programming, (4) sound production and recording, (5) communications law and ethics. Advanced degree required; PhD preferred. At least 5 years experience undergraduate and graduate teaching, (or equivalent practical experience in the communications industry desired). Salary commensurate with experience. Send resume to Prof. Richard B. Barnhill, Chairman, TCMF Search Committee, Room 372, Newhouse School of Public Communications, Syracuse University, Syracuse, NY 13210. Deadline for applications March 1, 1982. Syracuse University is an Equal Opportunity/Affirmative Action Employer.

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CES ARE NEGOTIABLE. MANY MORE MS UNLISTED–CALL IN YOUR WANT T. EACH CAMERA PROVIDED WITH PAIR DEPARTMENT SERVICE REPORT D ANALYSIS OF CONDITION. ITEMS RKED WITH BLACK STAR SPECIAL E IN REBUILT, RE-CONDITIONED LIKE W CONDITION. USED EQUIPMENT SUB-T TO PRIOR CASH SALE. WE SUGGEST W G & M NICAD OR LEAD ACID BAT-RIES FOR ALL USED CAMERAS. PRICES ON REQUEST.

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unlisted: animation cameras, printers, stands, cases, 70mm cameras)

hm CINEFLEX PH-330K body w/12 C mtr, estended VF, rewind crank, ver cable, $845.00
mm ARRIFLEX 2C, CS motor, 3- ' mags, Schneider 28, 50, 75 primes, hm macro killar, matte box, cable, e, $11,900.00
RRIFLEX 2B, VS mtr, 2-400' mags, tery, cable, $3,950.00
MITCHELL RACKOVER No. 59, 700.00
MITCHELL RACKOVER No. 09, 475.00
EYEMO 71Q spyder, $895.00
EYEMO 71, $790.00
RRI 2BV body only, $2,600.00
RI 35 2C Hi-speed, 28, 35, 50 Schnei- 2-480' mags, hi-speed motor control, mtr, cables, cases 12V, 30V batteries, ,100.00
RI 35 2C w/sync pulse gen, CS mtr, es, 2-400' mags, 3-Schneider primes, ' G/M battery, $10,800.00
RI 2C HARD FRONT, 2-400' mags, tal motor, cables, case, $8,850.00
RI 35 2C hi-speed, 2-400' mags, 3 nes matte box, CS mtr, cables, case, 200.00

16 CAMERAS

unlisted–more NPRs, CPIG's, ARRI L's, Filmo's, Eyemo's, cases, parts)
unlisted–more NPRs, CP 16, ARRI 16 BL's, Filmo's, cases, parts)
hm ARRI-S, VS mtr, 3-400' mags, 1- ue mtr, matte box, 4-primes, 17-70 cinor, $5,900.00
RI-16 BL w APEC, 10-100 Zeiss, te box, ARRI zoom mtr, 2-400' azines, power cables, battery, case, 500.00
DAK CINE SPECIAL II, 400' mag, hm EKTAR, $1,200.00
DAK CINE SPECIAL I, 2 primes, 5.00
OLEX HI6EBM, 16-100 vario switar, , pistol grip, cases, $1,950.00
6R, autometer, 2-400' mags, 2 batts, hagrs, maghead, amp, 12-120 ANG, 200.00
hm BOLEX H16 REX 5, 18-86mm, io-switar POE, MST motor, filters, tery pack, case, $1,900.00
hm ECLAIR NPR w 9-95 ANG., 00' magazines, Kinoptik VF, Beala , 2 power cables, belt, barney, cases, 400.00
16R CAMERA, 12-120 canon PLC- mag, crystasound amp, 3 batts, 1 r, case, $8,900.00
*ARRI 16 BL, Zeiss 10-100 E/2.8, crystalok, handgrip, 2-400 mags, barney, 12V GM battery, case, $9,545.00
ARRI-SRI, 400' mag, ang. 10-150 zoom, 2 batts, 1 chgr, VF ext, 2 grips, case, $18,500.00
*ECLAIR ACL, 2-400' mags, OVF, crystal mtr, cases, $8,900.00
ECLAIR NPR, 2-400' mags, ang 9.5-95, kino, VF, Beala mtr, 2 cases, $8,800.00
*ECLAIR NPR, 2-400' mags, ang 12-120, 2 batts, orient. VF, CIRPI CRYSTAL MTR, 2 cases, like new, $10,900.00
ECLAIR NPR w/crystal mtr, 2-400' mags, 12-120 cases, $6,200.00
ECLAIR NPR, 2-400' mags, canon 12-120 macro, kino. VF, crymo mtr, 2 cases, $7,500.00
*ARRI 16 BL APEC, 2-400' mags, off-set VF, 10-100 zoom, CP crystalok, barney, cases, $9,900.00
ARRI 16S VS mtr, sync mtr, ang 12-120, AC conv, torque mtr, 3-400' mags, matte box, cables, cases (syngen), $5,800.00
ARRI 16 S/B, VS mtr, CS mtr, 1-400' mag, 3 Schneider primes 16, 25, 50, T/2, $6,200.00
BOLEX H-16/RX5 Body, $1,800.00
CANON SCOOPIC 16 MS kits, batts, charger, gel holders, case, $1,700.00
ARRI S BODY, VS mtr, 400' mag, cable, $2,400.00
ARRI S BODY, VS mtr, 400' mag, cable, $2,700.00
ARRI S BODY, 2 mags, 1 torque mtr, 3 primes, VS mtr, cables, $4,600.00
ARRI 16M, VS mtr, 2-400' mag, 12-120 ang zoom, 12mm Cooke, 50mm Zeiss, cables, case, $8,100.00

AUDIO

(unlisted–battery packs, mounts, screens, mag stock, cables, many 16/35 record/reproducers)

NAGRA 4.2L Loaded, $5,000.00
*NAGRA III–rebuilt, $2,300.00
NAGRA SNN w/TSR-260 Resolver, $2,500.00
SHURE 267 MIXER, $245.00
SONY ECM 50 PS, $138.00
PERFECTONE Type EP6A sync, rec., $995.00
PERFECTONE, Mixer, $495.00
SENNHEISER 815, $520.00
SENNHEISER 850 w/batt pack, $350.00
SENNHEISER 804 w/batt pack, $270.00
SENNHEISER 404 w/batt pack, $170.00

EDITING

(unlisted–Rebuilt 16 and 35 upright moviolas, bins, racks, tables)

NEUMADE 70/35 COMBO sync block 1-70, 8-35 gang, $995.00
MOVIOLA 16mm LPV preview viewer, $1,600.00
*SHOWCRON 6 plate 16-1P-2S flatbed editor, $6,900.00
EDITING TABLE, lightwell, backrack, rewinds, bin, clamps, spacers, leader stanchion, lamp, 3-splits, 6 take-up reels, $475.00
16mm KEM RAPID 6 plate flatbed, $11,800.00
16mm 6 GANG SYNCBLOCK, $495.00
16/35 HFC MOD. FSC-1 hot splicer, $420.00
MOVISCOP VIEWER, $267.00
SRM-16 READER, $175.00
SRO-16 READER, $375.00
MAIER-HANCOCK 8/16 hot splicer, $375.00
16mm MOVIOLA UL-20-S, $2,850.00
35mm MOVIOLA UD-20-CS w/comp head, $3,840.00
4 GANG 35mm synch block, $210.00
3 GANG 35mm synch block, $195.00

PROJECTION

PROJECTION

(unlisted–Simplex, Century, DeVry, Peerless parts and components, theatre seats)

*16mm PALMER INTERLOCK with amp RP84, $3,900.00
SIEMENS INTERLOCK w/amp/speaker, $2,495.00
SIEMENS INTERLOCK w/amp, $2,100.00
SINGER GRAFLEX mag/opt, $575.00
35mm DEVRY, rebuilt w/stand, $1,950.00
16mm NORELCO w/incandescent lamp-house, $ POR
PAIR CENTURY TYPE "C" 35mm heads, changeover, lenses, stands, maga-zines, lamphouses, rectifiers, $8,900.00

LIGHTING

(unlisted–complete used studio lot of mole lighting)

COLORTRAN 6" sweep focus fresnel, $90.00
COLORTRAN 2K softlight, $195,00.
BARDWELL 1K fresnel baby keglight, $99.00
COLORTRAN mini-6, $77.00
COLORTRAN set light, $65.00
LOWELL SOFTLIGHT KIT S1-92, $385.00
LOWELL SOFTLIGHT 3-kit, $700.00

GRIP

42" x 42" REFLECTOR, $180.00
4 PLACE REFLEXTOR BOX, $170.00

SUPPORT SYSTEMS

(unlisted–many wood standard, baby pods & hi hats, pods, braces, parts)

MC ALISTER CRAB DOLLY complete, $7,900.00
CUSTOM DOORWAY DOLLY, $695.00
COLORTRAN DOLLY complete, $4,300.00
MITCHELL STD LEGS 35mm, $295.00
MILLER F FLUID HEAD, $445.00
MILLER STD BALL LEGS, $275.00
MILLER PRO BALL LEVEL w/B/S legs, $895.00
B/S ARRI BALL HI HAT w/ball, $35.00
ARRI BALL BABY LEGS, $125.00
BOLEX LEGS, $410.00
O'CONNOR CLAWBABY, $200.00
BILORA fluid action w/PRO JR legs, $250.00
MILLER PRO w/ARRI ball and ARRI std legs, $895.00
NCE ECL FLUID HEAD, ball leveling, $720.00
UNIVERSAL LEGS - 220, $220.00
PRO JR STD VGM 200, $150.00
PRO JR BABY, $110.00
CARTER CARPAC, $295.00
*MOLE RICHARDSON Perambulator boom, $ POR

MOTORS, MAGS, ACC

ARRI 35 sync mtr w/flat base, $500.00
*ARRI 35 2C animation motor - Norris (demo), $2,300.00
ARRI 35 VS mtr, $495.00
ARRI 35 CS mtr, $525.00
ARRI 16 torque mtr, $395.00
ARRI 16 CS mtr, $420.00
400' ARRI 35 belt magazine, $310.00
480' ARRI 35 gear magazine, $750.00
400' ARRI 16mm magazine, $400.00
400' BOLEX 16mm magazine, $310.00
400' PLC-4A 16mm magazine, $175.00
400' ACME 16mm 400L magazine, $295.00
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1200' MITCHELL 16, $320.00
1000' MITCHELL 35 NC, $295.00
1000' B&H BIPACK, $895.00
1000' MITCHELL hi-speed, $200.00
BOLEX EL underwater housing, $910.00
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PRIME LENSES

KINOPTIC 25mm f.2, $395.00
KINOPTIC 40mm, $410.00
ARRI-CINE XENON 1:1.4/24mm, $345.00
SCHNEIDER Arri-cinegon f:2/16mm, $450.00
COOKE KINETAL 17.5mm, $425.00
EXTENDER for angenieux 25-250, $149.00
ZEISS PLANAR 50mm, $785.00
SCHNEIDER Arri cine-xenon 25mm, $415.00
KINETAL 37.5mm, $395.00
CENTURY SUPER wide angle 5.7mm, $575.00
XENON 1:2 175mm, $350.00
ARRI KINETAL 37.5mm, $395.00
ARRI CINE-XENON 1:2/50mm, $415.00
ARRI CINEGON 1:2/16mm, $430.00
ARRI CINE-XENON 1:1.4/25mm, $345.00
KINOPTIC 50mm, $389.00
ARRI CINE-XENON 1:2/50, $325.00
ARRI CINEGON 10mm, $600.00
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KERN 25mm F1.4 Switar (C/Rx), $185.00
KERN 26mm F1.9 Pizar (C), $215.00
KERN 50mm F1.8 Pizar (C/Rx), $195.00
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ZOOMS

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ANGENIEUX ZOOM 12-120mm w/view-finder, $1,095.00
CANON ZOOM C-16 25-100 1:1.8, $495.00
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COOKE DEEP field panchro 100mm, mount, $450.00
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Guy (rhymes with "oui") Genin, Zellan's principal Service Engineer, shows how the 16mm Aäton LTR outwits a cruel world.

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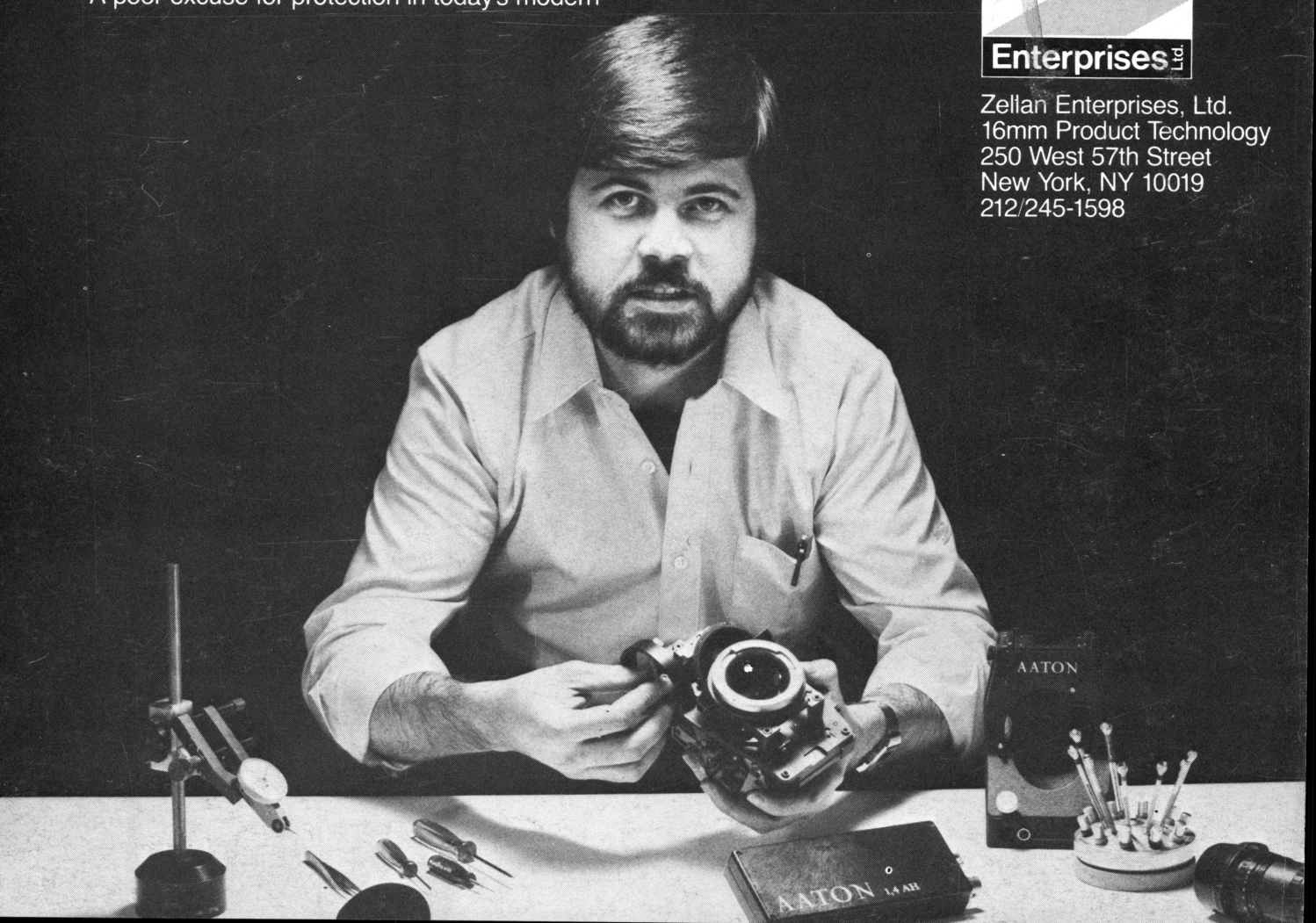
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